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THE SMALL CONSUMER.

It has been the fashion among some central station men to decry the small consumer as a nuisance and to pay scant attention to his needs. It has been assumed that he was an unprofitable customer and that the big fellow was the only one whose favor was worth the seeking. In particular, the residence customer with his large connected load and relatively small use has been in disfavor and held unworthy of concessions. Now, if one stops to look at it broadly, the fact is apparent that however it may be with the electric central station, the gas plant lives and moves and pays its dividends on the profits of the small consumer's business. It has been deprived to a considerable extent of the large consumers through the competition of electricity, but so far from being hard pushed has in fact flourished on the kind of business that some electric men affect to despise. Of course, it is true that the gas company has the advantage in cheap and easy storage, yet, on the other hand, residence lighting in particular has a peak that does not coincide with the general lighting peak and hence tends to the better utilization of the distribution system. The success that has been made in Detroit with residence lighting and other small work is quite sufficient evidence that the field is a profitable one if well worked; and since the small consumer is numerically strong and politically potent there is every reason to cultivate his good will.

Unquestionably a consumer whose bill will amount to but a dollar or two per month makes disproportionate demands on the general expense account. The reading and care of his meter, the time taken by his complaints, the cost of his bookkeeping and collection work, form an aggregate that cannot be left out of the reckoning. Yet there is another side even to this matter. If these items are considerable, does it not show that the central station's red tape department needs some overhauling? Instead of throwing up one's hands and turning the small consumer over to the gas company, would it not be wiser to set about internal reform? The gas company has to read his meter, listen to his complaints and painstakingly collect his petty bills, yet it cannot well afford to do without him. What one kind of central station does the other should be able to do, and these very items are the ones which are not affected by lack of storage or position of peak load in which the gas supply might be supposed to have the advantage. Is it not time to look for a cheaper and more easily cared for meter, better methods for getting at the consumer's needs and simpler methods of managing his accounts? Such things are by no means impossible and once worked out would remain a valuable asset for more purposes than the immediate one. The policy followed in Detroit has not only been to help the small consumer by meeting his needs, but to encourage him to larger use of energy by giving him a chance at a secondary rate. As a rule, the small consumer pays the maximum price and has little incentive to use his opportunities. That it pays to give him a

welcome is sufficiently evident from the Detroit results. No house or shop is too small to secure if one travels on the theory that electricity should be made a necessity instead of remaining a luxury. Gas development has followed this line with success. What are the electric stations proposing to do to meet the competition of the little mantle burners that tape less than 2 cu. ft. of gas per hour? It has been familiar abroad for some years and has just now found a commercial place here. Where are the small high-efficiency lamps that are to meet it? And how are American lamp makers going to meet the issue involved in that sort of competition? The world is moving rapidly in lighting matters and one must keep up with it even if the effort is distasteful. A deliberate and persistent effort to make electricity a necessity in the everyday life of the home will bring results if followed up, and the manufacturers must do their part—as they doubtless will when they get started.

Police Regulation of Central Stations in Germany

Some months ago the German Minister of Trade and Industry issued an announcement of a proposed set of regulations for future inspection of central stations by the department of police. The fact was announced and editorially commented upon in our columns at the time. It is difficult for the American mind to follow the process of thought by which the action of a city police department could be supposed to inspect a power plant without invading the mental precincts of humor or burlesque. In this country the functions assigned to the police are those of maintaining public order and of restraining open lawlessness. In Germany, however, many important civic functions are granted to the police over and above the maintenance of public order; so that there is nothing incongruous to the German mind in the idea of a police officer walking into a central station, examining the coal and ash circulation, the boilers, engines, switchboard, and making copious notes which shall serve as the basis of a subsequent departmental report and official admonition to the station manager. It is interesting to observe that the *Elektrotechnische Zeitschrift* has recently published a counterproposition to the above-mentioned proposed ordinances. At a meeting in May, called for the purpose, 55 delegates appeared representing various industries and technical societies. Resolutions were drawn opposing certain features of the proposed police ordinances, and a committee was appointed to prepare amendments to them. The report of that committee received the confirmatory signatures of the delegates, and appears to have been forwarded in a proper and business-like way to the Minister of Trade and Industry. It remains to be seen what action will be taken by the ministry upon the report.

Improvements in Tungsten Lamps.

We are glad to extend the hand of welcome to the 25-watt tungsten lamp, which has within the last month not only made its formal début, but taken a place quite in the middle of the stage. It is a most attractive little light and especially to be commended on account of its improved anchoring, which should insure security when the lamp is burned at an angle. Our manufacturers have been a bit slow in following the example of rather elaborate anchorage set by the European makers, but there has been steady improvement, and the smaller tungsten lamps at all events are now excellently designed for burning in any reasonable position. The 25-watt lamp in particular required this valuable property, since it stands in some respects in a position quite different from the other sizes in relation to its installation. The previous sizes put out did not exactly fill the place of lamps already in use. The 100-watt size has, so to speak, been installed and used strictly on its merits, the only carbon lamps of equal or greater reputed power being notoriously bad as regards useful life. Thus the 100-watt lamp has usually replaced inefficient clusters, arcs or Welsbachs, and has been put in with a suitable reflecting shade as an independent unit or installed in new fixtures also with proper shades. To a considerable extent the 60-watt size has been also freshly and properly installed, its size being such that only now and then is it seen in obviously and conspicuously unsuitable shades.

The 40-watt lamp has been less fortunate, as there has been a tendency to stick it into old shades instead of an ordinary 16-cp lamp. Its price has in a measure saved it, since there is little economy in its use save in cases where the extra light is needed, yet it has been rather a source of worry from the standpoint of proper illumination. It gets stuck in shades that merely form a fringe around the socket, and in shades in which it is entirely swallowed up. And in replacing lamps of less capacity it is often called upon to burn in every imaginable position. Now the 25-watt lamp is in even much worse case because it is openly and evidently a substitute for the common 16-cp lamp; is of practically the same dimensions, and is simply substituted for it lamp for lamp. Hence the 25-watt tungsten lamp will be thrust, regardless of propriety, into any socket where a lamp has found lodgment. It will be expected to do service in big shades, little shades and with no shade at all. It will be burned right side up and wrong side up and in all the directions between, used nakedly glaring into the user's face, and hid behind so-called "artistic" shades that call to mind the scriptural suggestion of hiding a light under a bushel. Still worse, it will be handled by the bungling fingers that cannot get at a lamp in a ceiling fixture, shoved into shaky table lamps and swung pendulous from drop cords. Wherever a man has had a 50-watt carbon lamp he will thriftily thrust in a 25-watt tungsten and then will raise a howl of protest if it goes wrong. The 25-watt lamp is up against the stern realities of misuse to an extent incomparably greater than in the case of its larger predecessors.

With all seriousness, while the little fellow is going to be immensely useful, central stations must view its advent with rather mixed emotions. Its lessened consumption of energy should give no cause for anxiety, since the certain result will be very much to encourage the more extended use of electricity. The trouble is that the very slender filament is necessarily more fragile than in the larger sizes, and that the lamp itself will be put in very trying situations. Most incandescent lamp fixtures put the lamp on an angle where the ordinary shade is comparatively ineffective and does not shield the filament. Now the intrinsic brilliancy of a tungsten lamp is very much higher than that upon carbon lamps, and it is correspondingly harder upon the eyes. The need of liberal frosting on the bulbs of these little tungsten lamps is, therefore, acute, and it is to be hoped that manufacturers and central stations will unite in pushing a half-frosted or wholly-frosted bulb for use in all fixtures where the lamp is not otherwise adequately covered. A bare tungsten

lamp should be used only in fixtures that completely hide the filament. Perhaps one of the valuable features of the lamp may turn out to be its demand for more carefully designed shades, but there is very likely to be a stormy period before this demand is met. With the large numbers of lamps in use that the small size encourages, early blackening and premature breakage will become far more conspicuous than at present, and kicks will be correspondingly numerous and violent. The breakage bills, in fact, will certainly be much greater in proportion to the energy bills than in the larger sizes of lamps, and the profit to the user will be correspondingly less, although still large enough to be of importance. We are heartily glad to see the 25-watt lamp coming into extensive use, and realize that it fills a long-felt want. It certainly does, however, demand more careful handling and more watchfulness in proper installation than the larger lamps heretofore introduced. Abroad there are even 20-hefner lamps, and the 25-watt lamp has been in use for some time, and the same trouble of improper use is conspicuous. The chief dangers are inefficient shading, which can be lessened by encouraging the more general use of frosted lamps, and excessive breakage, which can be avoided only by caution in installation and care in use. The lamps are not at all impracticably fragile, but they cannot be handled, like carbon lamps, with impunity.

CIVIL ENGINEERS AND THE METRIC SYSTEM.

A most interesting report has recently been printed by the American Society of Civil Engineers as an announcement in advance of the annual meeting of Jan. 20, 1909. It may be remembered that all of the scientific societies in America that have expressed themselves on the subject of weights and measures have urged the Congress to adopt legislation introducing the metric system into America. Among the technical and applied-science institutions, with the engineering societies as prominent members of this class, the resolutions have been divided. The American Institute of Electrical Engineers has, on several occasions, urged the introduction of the metric system by the U. S. government. A ballot upon this question mailed a few years ago to all the members of the Institute brought an unusually large number of replies, and about 80 per cent of the replies were in favor of such action. The Franklin Institute, and various engineers' clubs, have, at different times, similarly urged metric reform, likewise the American Institute of Architects, the National Association of Builders, and the Western Association of Architects. On the other hand, the American Institute of Mechanical Engineers has opposed the introduction of the metric system, although, judging by the increasing vehemence and duration of debates upon the subject in recent years, it would seem that there is a growing minority of the members in favor of metric reform. The principal objection to the introduction of the metric system on the part of the American Institute of Mechanical Engineers appears to be the expense involved in the change to manufacturers.

The report here considered, of the special committee of the American Society of Civil Engineers, is strongly in favor of adopting the metric system and of urging Congress to introduce it by legislation. We are heartily in favor of the metric system, not merely for scientists and engineers, but also for the average citizen, and we cordially endorse the special committee's report. As a matter of detail, however, we are inclined to think that it goes too far, since it recommends that Congress should make failure to comply with the metric system after a certain prescribed date punishable by fine, or imprisonment, or both, as the court may direct. We think that this is going too far, and that no man should be punishable for adhering to the system of weights and measures with which he was brought up. It would be sufficient in our opinion if the various departments of the U. S. government were to adopt the metric system exclusively, on and after a certain date. Some of these departments use the metric system already, such as the postal department, the treasury, the army, the navy, the Bureau of Standards, the Coast Survey and others. None of them, however, uses the metric system exclusively, although we have been informed that some would prefer to do so, in order to save themselves time, trouble and expense.

The constant dread of manufacturers not interested in export trade is that such legislation would plunge them into heavy and unnecessary expense. This is a very real fear with them, and one which it is very natural they should entertain when the proposal first reaches them. They commonly think that the introduction of the metric system would make all their tools and machinery useless, and that they would have to replace the greater part of the plant with new machinery in metric sizes. With large amounts of capital invested in such plant, it is no wonder that the owners are timid of metric legislation. In the opinion of metric system advocates, however, the above fears are greatly exaggerated. The best and most reliable guide in this question is the experience of other nations, and particularly of Germany, which about 30 years ago adopted the metric system, by governmental act, within a few months of the passage of the resolution. The change was made within a few weeks in the government departments, within a few months in the cities and larger towns, and within a few years in the more remote country districts. It is well known that the actual expense incurred in the change was trifling. No tools or machines were rendered useless. The same old tools or machines were used after the change, and their output was merely measured and recorded in the new units, instead of in the old units. Very gradually, as the old machines wore out, the new machines to fill their places were, as a matter of convenience, slightly modified in detail to produce convenient metric sizes; but there was no appreciable hardship in a pecuniary sense. It is only fair to say, however, that the change involved some effort and inconvenience at the time, which might perhaps be given an estimate in money value. Persons in Germany who were accustomed to buy by the inch, pound, and ell, had to change their mode of thinking to buying by the centimeter, kilogramme and meter. It was, however, the consensus of opinion that the advantage gained by the simplicity of the new system far outweighed the trouble that the nation encountered in making the change.

We hope that the American Society of Civil Engineers will aid the cause of international comity and civilization by adopting and acting on the report of its special committee. It is time that our nation took steps to get rid of this incubus of an outworn jumble of weights and measures, which brings a smile of pity to the countenance of every continental European.

Conference on Electrical Units.

The International Conference on Electrical Units, which was called together in London, as noted on page 887 of our issue for Oct. 24, elected Lord Rayleigh as chairman. A technical committee was appointed to consider in detail and to draft specifications for the ohm, the ampere and the volt. A resolution was passed by the conference adopting the c.g.s. electromagnetic system as the basis of measurements. In a discussion upon a further resolution that the international ohm shall be defined as the resistance of a specific column of mercury, Dr. E. B. Rosa, of the United States, suggested that the length be specified as 1 m. This point was referred to the technical committee, by which it was negatived by a vote of 14 to 5. The adoption of the ampere as the second primary unit was decided upon at the meeting of the conference on Oct. 14.

The discussion concerning the second primary electrical unit was opened by Dr. Glazebrook, of England, who moved that "the ampere be the second primary unit." He stated that the adoption of this unit would involve no change in the practice of any of the countries represented. The standard cell is less accurate of reproduction and less permanent than the silver voltammeter. He said that practical difficulties due to the use of the Clark cell are becoming very serious. Dr. Warburg, the leading German delegate, seconded the motion.

Prof. Lippmann, of France, proposed that the volt, and not the ampere, be the second primary unit. Dr. H. S. Carhart said that some three years ago Lord Kelvin wrote him strongly approving the modern method of measuring currents by resistances and standard cells. Dr. E. B. Rosa, of the United States, referring to the permanency of cells, mentioned one which had made the circuit of the world and remained constant in value. M. Gerard, of Belgium, favored the ampere as the second primary unit, and the resolution to that effect was carried by 19 to 4. The minority represented the United States, France, Denmark, Sweden and Paraguay.

Electric Freight Tubes for New York.

At a meeting of the New York Traffic Club, at the Hotel Astor, on Oct. 28, the scope and plan of the proposed electric underground freight service project was explained by Mr. H. J. Pierce, vice-president of the Amsterdam Corporation, who read a paper on "The Freight Problem on Manhattan Island."

"The incapability of enlargement of available water frontage on the commercial portion of Manhattan Island," he said, "makes it apparent that some method of land carriage is necessary that will practically eliminate the need for railroad space on the water front. The tonnage that more vitally affects the matter, however, is that which requires draying on the city streets. The total for the year 1907 of tonnage of the principal railroad and water carriers requiring drayage in Manhattan was 23,200,000 tons, of which 19,200,900 tons was merchandise and 4,000,000 was coal.

"The new system is to consist of a freight terminal belt line in New Jersey, having connecting yards at its intersections with the railroads that have their terminals on the North River, namely, the Pennsylvania, the West Shore, the Erie, the Lackawanna, the Lehigh Valley, the Central Railroad of New Jersey and the Baltimore & Ohio. The freight will be transferred in these yards to 10-ton cars of the Terminal Railroad and afterward assembled in classification yards at a central point and taken by tunnel under the Bergen Hills and under the river to the freight subways to be established upon Manhattan Island. The cars will be electrically operated by the multiple unit system.

"A belt-line freight subway with four tracks is to be built along the river front from connection with the New York Central freight yards at Sixtieth Street and the North River to the Battery, and thence with two tracks along the East River to connect with the New York, New Haven & Hartford and New York & Harlem freight yards in the Bronx, with a main crosstown line somewhere between Twenty-third and Forty-second Streets. The piers around the water front will have connection with the belt line, and spurs will extend under the sidewalks direct to the buildings occupied by the principal shippers and receivers of freight in the congested districts. Coal will be delivered to the cellars of all large buildings and ashes removed. It is proposed to establish transfer stations at intervals of one-half mile, where the car bodies bearing classified freight would be put upon auto trucks for street delivery to points where the amount of freight would not justify lines being extended under the sidewalks."

The cost of this plan was stated by Mr. W. J. Wilgus before the Public Service Commission last summer to be from $80,000,000 to $100,000,000.

Alaska-Yukon-Portland Exposition.

The Alaska-Yukon-Portland exposition will be of more than passing value to the University of Washington, on whose campus the exposition will be held. Three of the buildings, the auditorium, the fine arts and the power plant, are of reinforced brick construction and will be used by the university permanently. At present the university electrical engineering experimental department is combined with the machine shop and gas-engine laboratory, and the whole crowded into the old lighting and heating plant. The old power plant contains two 60-kw, single-phase, alternating-current generators and one 75-kw, direct-current generator, belt-driven through a shaft driven by a 115-hp McEwen and a 120-hp Ball engine. The steam for testing purposes, for the heating of the buildings and the engines is supplied by two Erie boilers fed with Green chain grate stokers. When the old plant is abandoned most of its equipment will be used for testing purposes in the university laboratories.

The new plant will be used for exposition purposes during its progress and then turned over to the university. The building is of reinforced brick construction, divided into a boiler room and engine room, both on the ground floor, and an outside concrete coal storage bin, 50 ft. x 50 ft. x 11 ft. high, over which a railroad spur track is arranged so that coal can be dumped directly without hand handling.

Two water-tube boilers of 112 4-in. tubes, each fitted with chain grate mechanical stokers, are now in place. The two generating units being installed are direct-connected, three-phase, alternating-current Westinghouse machines and will be ready for operation about Jan. 1.

The plant will light and heat all of the buildings on the campus through a tunnel. The testing department will be in the new Science Building now being built for exposition purposes. The Hallidie Machinery Company, of Seattle, Wash., has the contract for equipping the plant complete.

The transportation companies are beginning early and making elaborate preparations for handling the exposition crowds, extra trackage and terminal facilities being placed to that end. The Union depot on King Street now handles somewhat over 5000 people a day over the Great Northern and Northern Pacific roads, and will be large enough to accommodate the exposition traffic. To handle the crowds during the exposition, the Northern Pacific and the Great Northern are laying extra tracks, building new yards and sheds, and intend to have adequate terminals with connecting lines so that there will be no delay through congestion. The Chicago, Milwaukee & St. Paul expects to have its new extension finished for traffic.

The Seattle Electric Company is making extensive preparations to handle the crowds. The university car line, which goes directly past the exposition grounds, is being laid with four parallel tracks along the exposition grounds and being double-tracked through to the down-town district. The Pike & Broadway line has been extended to meet the university line at Martin Street. The Wallingford Avenue line reaches the exposition grounds from the north, thus giving three car lines, which, with the suburban railroads, ought to be sufficient to handle the crowds.

The Testing and Reading of Meters in New York City.

At a hearing Oct. 26, before Commissioner Milo R. Maltbie, of the Public Service Commission of the First District of New York, in the investigation of the electric companies of the city, the questions of reading and testing meters and of handling the allowances claimed were taken up. Mr. Arthur Williams, chief inspector of the New York Edison Company, detailed the methods of handling applications and entering into business relations with a customer. The first thing to be done, said Mr. Williams, was to investigate and see whether the current could be supplied; whether there was a main on the premises or near by. In the case of a new building, the first question was to find whether or not a special appropriation for an extension would be necessary. An inspector was sent to see whether the application conformed with the company's requirements, to investigate as to the wiring and to count the installation so as to determine the size of the meter. The insulation, Mr. Williams said, was not tested unless some question was raised as to the leakage of the current, but the reports of the company's inspector, the city inspector and the insurance inspector were compared and considered jointly. No current could be turned on until after the company had received the city and underwriters' certificates. When these were received a connection order was issued, the meter installed and the lamps placed; the final step was the insertion of fuses. The company's inspection was held to be necessary in addition to the official certificates as the company had some requirements, such as balancing the installation between the two sides of the system, which were not included in the official codes.

Before these matters were settled, Mr. Williams explained, the application was sent to the auditor, who examined the applicants' financial standing. This being found satisfactory, the service order, meter order and inspection order followed, all three being made on one sheet.

With regard to the manner in which meters are installed Mr. Samuel G. Rhodes, engineer of the meter department of the New York Edison Company, said that meters were installed after being thoroughly tested in the company's laboratory, but that no test was made on the premises at the time of installation. Within 48 hours a meter expert visited the installation and put current through the meter to determine its direction and method of connection and to certify that the meter was in operating condition. This inspector opened the meter and removed whatever wedges or lugs there might be left in it and then resealed it, certifying to the seal that was found on it, but making no new test of its accuracy. Within three or four weeks a test was made for accuracy. This inspector had a card of identification which bore his signature and if the customer was suspicious the inspector could be made to identify himself by his signature. The company had found this a better process than the use of a badge, which could be easily transferred. The company also thought this system much better than the use of uniforms or caps. Mr. Rhodes said that every meter was serially numbered and a meter was not numbered and placed in the stockroom until it had passed the laboratory test. When a meter was tested it was considered all right if it showed within 1 per cent either way of absolute accuracy. The tests were made at light load and full load and alternate current meters were tested at power factor of 7. The test made several weeks after the meter had been installed was always made at light load.

At this point Mr. J. W. Lieb, Jr., assistant general manager, interrupted to say that the reason the second test was set at a period of from three to five weeks was because a series of experiments had been made with new meters a few years ago, and it was discovered that the commutator, which in a new instrument was apt to be greasy, settled down and became stable after about a month's use. He said it was found that after a month's use the condition of the meter became permanent. The method of testing meters, Mr. Lieb said, was that installed by the Public Service Commission. He also said that the men who made the meter tests were, as a rule, graduates of technical schools and experts in their business. After the test at the end of a month the meter was not again tested out of regular order except at the request of a customer. Every meter was tested at least once a year, but large meters were tested more often. Meters in unusual places, such as the Pennsylvania tunnel and the city pumping station, were tested more frequently. Mr. Lieb stated that the reports of meter variations were tabulated monthly, but at the commissioners' suggestion he said there would be a decided objection to making these statements public.

Mr. W. M. Edwards, who had charge of the meter reading department, testified that the regular periods for reading were once a month or once a week. The city, he said, was mapped into districts and readings were begun the first day of the month and finished on the twenty-fourth. The readers reported on different colored sheets for the different kinds of meters. He said that many large consumers insisted upon the meter being read in their presence and they made memoranda of the index numbers. All questions of dispute were referred to the inspection department and adjustments made.

Industrial Training at Lawrence, Mass.

The Lawrence Industrial School opened Oct. 19, with an enrolment of over 900 students. This institution represents a new phase of technical education in Massachusetts, and is of interest to engineers in general, although designed primarily for increasing the efficiency of workers in the textile and metal trades. It has both day and evening courses, tuition being free, with no entrance examinations, the only restriction being that the student must be a shop or mill operative. The mechanical equipment of the school has already reached the value of $32,000.

Aside from the courses in textiles and industrial chemistry, one of the strongest departments of the school is the course in steam engineering and electricity. This course is provided with lectures by practical men skilled in their respective branches, with arithmetic and practical mathematics for engineers, firemen, etc., and laboratory practice in steam engineering. The laboratory equipment is excellent for giving a practical idea of the more common steam and electrical machines. The Lawrence school is under the immediate direction of William H. Dooley, and is the only independent industrial school in the State with a separate board of trustees and independent buildings. The purpose of the school is to provide training for students who could not assume the burdens of a four or five-year course at a professional engineering college, either from the financial or preparatory standpoint. It is felt that the education received in the higher technical institutions does not entirely fill the needs of the industrial world, tending to create experts and administrators, while the rank and file of the industrial employees need a less severe curriculum, but one which will increase their usefulness and individual prospects notwithstanding the more elementary character of instruction which they can assimilate.

Arc Lamp Electrode.

A patent issued Oct. 27 to Willis R. Whitney on an application filed Dec. 10, 1903, describes a means for improving the operation and increasing the efficiency of arc lamps by improving the quality of the electrodes employed. The claims cover an arc light electrode formed out of a pure metal having a melting point materially higher than iron and yielding a luminous or flaming arc; the metal having a good electrical conductivity, and melting at a temperature exceeding 2000 deg. C. The metal may be either titanium, molybdenum, tungsten, chromium, thorium or uranium. It is stated that electrodes formed from these materials are very slowly consumed in the normal operation of the lamp and give a luminous or flaming arc, which furnishes a very intense light of an excellent color. Such electrodes may be employed as negative electrodes in connection with non-condensing positive electrodes.

New York Meeting, American Electrochemical Society.

The fourteenth general meeting of the American Electrochemical Society was held in New York City on Friday and Saturday, Oct. 30 and 31, and proved successful in every respect. The number of those who registered was beyond 200. The two sessions of Friday were held in the Doremus Lecture Hall of the fine new Chemistry Building of the College of the City of New York. During the morning session President J. H. Finley, of the college, welcomed the visitors, while during the afternoon session Dr. Charles Baskerville, head of the Department of Chemistry, took occasion to explain the engineering features of the Chemistry Building. During the noon recess between the two sessions the members and guests were entertained by the staff of the Department of Chemistry at luncheon and enjoyed an organ recital by Prof. S. A. Baldwin, head of the Department of Music, in the auditorium in the Main Building.

On the evening of Friday a subscription dinner was held at Reisenweber's in which more than 100 participated. President E. G. Acheson, of the society, made an inspiring address in which he spoke of the great national movement recently started to conserve our natural resources. He emphasized that no one should take a more prominent place in the proposed work than the electrochemist. Following the hydraulic and electrical engineers, the electrochemist should, by means of the electrical energy resulting from the utilization of our waterfalls, transform many of the present chemical and metallurgical industries into electrochemical and electrometallurgical ones, and he should greatly extend the list of products now used in the industrial world. Mr. Acheson spoke of the present time as the dawn of the era of electrochemistry.

The session of Saturday morning was held in the lecture hall of the Chemists' Club. During the afternoon of Saturday an excursion was made to the Balbach Smelting & Refining Works in Newark, N. J., where the processes of smelting and refining of copper, lead, silver and gold were shown in operation. This is the pioneer plant of electrolytic copper refining in the United States, having started operation 25 years ago. This is also the plant where the Balbach process of parting silver and gold was developed. On the evening of Saturday a smoker, which was tendered to the American Electrochemical Society by special invitation of the Chemists' Club, was greatly enjoyed.

The next general meeting will be held in the spring in Niagara Falls.

In the following we give abstracts of papers presented:

FRIDAY MORNING SESSION.

The papers of Friday morning were chiefly of a scientific character. The first paper related to the use of a mercury cathode in the determination of metals, the authors being Messrs. A. Harold Porter and Francis C. Frary. The chief conclusions are that the electrolytic determination of zinc with a mercury cathode gives low results, due to loss of both zinc and mercury in the process of washing with alcohol and ether. Pure mercury does not lose weight appreciably when washed with water, alcohol and ether, nor by liberation of hydrogen on its surface even at high temperatures (1000 deg. C.). The loss in weight during washing seems to be peculiar to zinc, since copper amalgam shows no signs of it, and the determination of copper by means of mercury cathode is quite satisfactory.

A paper by Prof. E. P. Schoch dealt with the passivity of nickel and iron. After a review of various theories on the nature of the "passive state," an account was given of experiments, especially those relating to the existence of an oxide film. The paper is chiefly of a chemical nature.

A paper by Dr. J. E. Mills on chemical energy dealt with the reaction between hydrogen and oxygen gas, forming water, when the chemical reaction is started by means of an electric spark. The chief object of the paper is to account for the energy given out by the reaction. The author appears to distinguish between the energy involved in chemical and physical processes. In the present case, at least, and perhaps more generally, the energy of chemical affinity is independent of the temperature, and the change of the total energy of a chemical reaction with change of temperature is accounted for as being used to effect purely physical changes; namely, to do external work, overcome molecular attraction, and effect an increase in the translational and internal motion of the molecules. The paper is naturally of a highly theoretical character.

Dr. G. A. Hulett discussed in an elaborate paper the chemical equilibrium in standard cells, both in the Weston and the Clark cells, with special reference to hydrolysis.

Prof. G. W. Morden gave an interesting account of experiments on the formation of nitric acid from air by means of low-voltage, direct-current arcs. A specially interesting conclusion from these experiments, which were made on a laboratory scale, seems to be that the combination of nitrogen and oxygen in air as the result of electrical discharges can hardly be a purely thermal phenomenon (as was generally supposed a few years ago), but that there is probably a specifically electric effect involved. The use of a low voltage and of direct current are novel features in experiments on the fixation of atmospheric nitrogen.

The afternoon session of Friday was devoted almost completely to a number of papers and discussions on the corrosion of iron and steel. Prof. A. F. Ganz was the introductory speaker. He distinguished between the corrosion of iron and steel structures when there is an external source of current and when not. A number of questions should be definitely settled. First, under what conditions can iron be brought into the passive state? Second, methods should be devised to identify the causes of corrosion so that it would be possible to say whether a particular case is due to starry currents or not. Third, is it possible to protect an underground metal structure by paints or by embedding it in cement or both? Fourth, what is the effect of breaking up the continuity of an underground system, like a pipe, by means of insulating joints? Fifth, what is the safe current density of a pipe; that is, what is the maximum current density for which corrosion will not occur?

In the discussion which followed Mr. Carl Hering said that there is no safe current density. If current leaves a pipe, whatever the strength of the current may be, visible corrosion will be the result if the action continues long enough. Dr. Cushman and Mr. Toch emphasized that all corrosion is primarily of an electrolytic nature, whether current from an outside source is present or not.

The second paper was presented by Dr. Clayton H. Sharp, who reviewed the correct methods of measuring stray currents. The investigation of the electrical conditions along a system of water or gas pipes in the ground is not easy. The main question is whether at any point any considerable amount of current leaves the system of pipes. In such investigations the voltmeter and millivoltmeter are sometimes employed with alarming results, but when properly used they can give valuable indications. When the rails of the trolley line are found to be positive with respect to the system of pipes, the pipes are safe. If the pipes are positive with respect to rails or other steel structures the pipes *may* be in danger, but this is not necessarily so.

The determination of the amount of current in the pipe would be easiest by inserting an insulating joint and connect an ammeter to points at both sides, but this is not always feasible. In general it is necessary to employ indirect methods. One is to measure the potential drop along the pipe, but to determine the resistance per unit of length is difficult.

It is particularly important to determine the current leaving the pipe. Valuable indications may be obtained by determining the electric conditions of the soil in the vicinity. A continual potential drop in the soil at points in the vicinity of the pipe indicates that electricity is flowing from the pipe.

Dr. Sharp also described Haber's earth ammeter, but remarked that it changes the electrical conditions in the soil.

There is no one standard method available for use in all cases and it is necessary to employ one or the other method in accordance with the special conditions of each case.

Mr. A. A. Knudson presented a paper describing some particular cases of the corrosion of the bottom of oil tanks and some other structures.

Dr. W. H. Walker discussed in an elaborate theoretical paper the important functions which oxygen has in the corrosion of metals. He also spoke of the corrosion of barb wire fencing, and suggested a method for overcoming the difficulty in this case. It is to pass the wires before subjecting them to the hot process, through a galvanizing tank in which zinc is deposited on the ends of the barbs.

Mr. Maximilian Toch spoke on the use of paints for the prevention of electrolytic corrosion. If it is possible to keep water away from any steel structure no corrosion is possible. This may be accomplished by using an insulating paint and embedding the painted pipe in cement. It is wrong to speak of protecting a pipe by means of concrete. It is the only cement that protects the pipe. By embedding a pipe which has received a layer of insulating paint in pure cement Mr. Toch thinks that the pipe would be protected for all times. Both the papers of Dr. Walker and Mr. Toch were illustrated by various interesting exhibits.

The only paper of the afternoon session not dealing with the corrosion of iron was a discussion by Dr. W. D. Bancroft of the program which he has worked out for a complete study of methods of making paints (especially white lead) by electrolysis. It is first of all necessary to study in detail the effects which a change of the conditions of the experiments (for instance, a change of temperature) has on the properties of the product. In experiments with copper oxides, it was possible by changing the conditions to produce a wide range of different colors.

SATURDAY SESSION.

The first paper of the Saturday session was presented by Mr. F. A. J. FitzGerald on the Lash steel process and the electric furnace. The broad principle of the Lash process consists in making an intimate mixture of finely-divided ore, cast-iron and carbon, and submitting this mixture to heat, when if the proportions of the constituents of the mixture have been properly adjusted, the desired grade of steel is produced. The essential features of the process seem to be the fine state of division of the constituents of the mixture, their intimate association, and the use of iron containing metalloids and especially manganese in considerable quantities.

The process may be carried out either in an open-hearth furnace or in an electric furnace. In experiments of the author with the Lash process, carried out with 60 per cent ore and 23 per cent cast-iron, in an electric furnace of the Héroult type, it was possible to obtain complete reduction of the charge with an expenditure of 0.27 hp-year per ton of steel, and to turn out a finished product with an energy consumption of 0.33 hp-year per gross ton of steel cast.

Mr. Woolsey McA. Johnson then presented a paper on "The Latent Heat of Vaporization of Zinc." The figure has not been determined experimentally, but it is possible to make a reliable calculation on the basis of the second principle of thermodynamics. The result is 388 large calories per kilogram of zinc. The paper is interesting as showing the possibilities of employing the methods of thermodynamics for finding constants which have not yet been determined by experiment.

Mr. Carl Hering presented an elaborate paper on "The Conduction of Heat Through Furnace Walls." Calculations were made both with the usual approximate formula and with an exact formula, and it was shown that the employment of the ordinary approximate formula may result in errors of 100 per cent or even more in special cases. One set of curves showed that in increasing the thickness of the walls it does not pay to go beyond a certain thickness, because any further increase of the thickness has only an insignificant effect on the saving of heat.

Mr. Hering also presented various sets of interesting diagrams showing how much the thickness of the walls of the furnace must be increased, if its volume is increased, in order to allow the same heat loss through the walls. Some of the results were very surprising.

The heat loss through furnace walls may be diminished in certain cases both by heating or cooling the outside walls of a furnace. If they are artificially heated (for instance, by means of illuminating gas), the drop of temperature in the furnace walls and therefore the heat loss is reduced. If, on the other hand, artificial cooling of the walls is employed, part of the charge is chilled and is then a much poorer heat conductor.

The paper elicited quite an animated discussion in which the desirability of determining experimentally the numerous data on heat conductivities and their change with temperature, etc., was brought out. Reference was made to Peclet's old work.

The last feature of the program was a discussion on the possibility of utilizing the energy of central stations during the hours of low load for carrying out electrochemical and electrometallurgical processes. The subject was introduced by Mr. E. A. Sperry in a recent conference, who noted what he thought to be a certain undertone of disappointment on the part of the station proprietors as to the prices that can be obtained from electrochemists. Mr. Sperry claimed that on the Canadian side of Niagara Falls it is now possible to get energy when bought in large amounts at something like $10 (or at least at less than $12) per hp-year. As to the possibilities of working electrochemical processes in connection with a lighting and power station, he referred to a plant in Maine in which this has now been successfully done for about three years. Progress in this direction is possible only by continual agitation. Electrochemists should acquire the habit of thinking about intermittent processes while central station men should consider what they can do in the line of prices.

In a second paper on this subject, by Mr. John Meyer, the viewpoint of the central station engineers was represented. In the absence of Mr. Meyer it was read by Mr. Graves.

The paper emphasized the importance of the load factor. The maximum possible output of any plant cannot be maintained continuously. The actual output is a certain percentage of the maximum and may be considered as the average. The ratio between the maximum and the average may be expressed in terms of load factor as illustrated in the following example: If a plant having a maximum rating of 100 units per day, and the average represents 60 units, then the load factor may be represented as 60 per cent, indicating that the average output was 60 per cent of the maximum possible. If the energy required to perform an operation is in direct proportion to the output of the product, then in the example stated above it is fair to say that although the maximum may be required at intervals, the average load will represent only 60 per cent of the maximum. Applying this principle to the rate of $30 per annum per horse-power of the equipment, because of the average load being but 60 per cent of the rating, the cost of energy becomes actually $50 per hp-year.

In French electrochemical plants the actual load factor varies from 50 per cent to 60 per cent based upon a 24-hour 365-day year. In other words, the cost per hp-hour is not the actual cost divided by 365 times 24, but it is a figure which is obtained by multiplying the equivalent 8760 hours by the load factor in percentage and dividing this resulting figure into the cost per year per horse-power will produce the actual cost per hp-hour.

In deciding on the question of location of an electrochemical plant it is highly important to consider the advantages of large cities in which central stations are located, since they may offer better facilities of obtaining raw material and a near market for the finished product. Mr. Meyer also cited several recent developments in this line which he hoped will lead to further developments in the future.

The paper was discussed at great length by a very long list of speakers in which the central station side was well represented by several engineers of the Brooklyn Edison Company. The net result of the discussion may perhaps be summed up

in the statement that for many electrochemical processes it would not pay to work intermittently or even to work with a reduced load at certain hours. On the other hand, for the use of smaller electric furnaces, such as will probably soon be used to a large extent in steel works, steel foundries, brass foundries, etc., intermittent working would easily be possible. A case was cited where electric furnaces are used in a Swiss steel plant, energy being furnished at a satisfactory price (less than for motor purposes in general) by the central station.

After the usual motion of thanks to all who made the meeting successful had been carried the meeting adjourned.

Civil Engineers and the Metric System.

The October *Proceedings* of the American Society of Civil Engineers contains a report of a committee of that body on the subject of the metric system, the committee consisting of Mr. Stacy B. Opdyke, contracting engineer, and Mr. David Molitor, assistant engineer with the Panama Canal Commission. The report will be presented for action at the annual meeting of the society on Jan. 19, 1908.

The report is very strongly in favor of the adoption of the metric system in this country. Referring to the erroneous impression created by presenting a full table of the metric system without explanation, it is pointed out that the general public will require but few of the units, and that the system in fact is so simple in theory and practice that anyone of average intelligence can learn it in one hour, and can think in it in a few days. A section is devoted to a legal status of the metric system in the United States in which it is pointed out that foreign postal rates are based on the metric system, metric weights are used in United States coinage, Congress has adopted the metric units for electrical measures, the system has been required in the medical work of the Navy Department since 1878, in the medical work of the War Department since 1894, and in the U. S. Public Health and Marine Hospital service. During the last 30 years nearly all surveys made under the Army Corps of Engineers, especially on the Great Lakes, the work of the Mississippi River Commission and the U. S. Coast and Geodetic Survey have been made in the metric system though the charts were all published with feet and metric scales. The metric system has been made obligatory in Porto Rico, and Congress has directed that the use of the system in the Philippine Islands shall be continued.

The case for and against the adoption of the system is presented, the latter under the heads of expense and inconvenience, one additional system, and antagonistic public opinion. As to the first mentioned objection, it is stated that expense and inconvenience are inseparable from any change in present units of measurement. As to the objection of the one additional system, it is stated that this is a common misconception betraying gross ignorance of the whole subject, as the plan is to adopt one system which will fulfill all human requirements and relinquish all other systems to the relics of the past. As to antagonistic public opinion, this is declared to have been brought about by the unwarranted efforts on the part of some manufacturers who believed that their immediate pecuniary interests might suffer, which short-sightedness is stated to result not only in a future pecuniary loss, but retards all progress of the world. In its consideration of many measures looking toward the adoption of the metric system, Congress has given more weight to the petty objections of a few money interests than to the concerted arguments and efforts of the scientific world.

A number of pages is devoted to the discussions of the arguments for and against the metric system, and it is pointed out in detail with respect to specific cases of importance how little difficulty would, in fact, be encountered in its adoption. For example, it is shown that in a metric pipe system the even nominal metric sizes are in nearly every case nearer the actual pipe sizes than are the nominal inch sizes; and that in very many important branches of industry the tolerance of 3 per cent in sections would enable commercial sizes to be expressed in whole millimeters with sufficient accuracy to come within the actual variations of trade sizes. It is also pointed out that the opposition to the metric system so frequently waged by manufacturers of roller mills, etc., is not well founded, because the templates, rolls, etc., could all be continued in use until worn out, if this proved desirable.

It is shown that England, Russia and the United States are practically the only non-metric countries in the world. As to Russia, this country has done everything possible to prepare for the change, and in this respect is rapidly approaching the point where the metric system can be exclusively adopted; this country can, in fact, now be considered a metric country. As to England, its attitude is indicated by the fact that in 1900 there were 96 members of Parliament in favor of the metric system, in 1906 this number had increased to 414, while a vote in 1907 barely failed to pass a bill for its adoption.

Notable Protection from Lightning in Colorado.

A paper was read before the Colorado Electric Light, Power and Railway Association at its Glenwood convention, Sept. 16 to 18, 1908, by Mr. John A. Clay on the "Lightning Arrester Equipment on the Animas Power & Water Company's System," of which company he is manager. This took up the remarkable amount of trouble experienced on that company's lines the past two seasons and the means whereby these troubles had been almost entirely overcome the past season by improved types of

FIG. 1.—17,000-VOLT LINE.

lightning arrester equipments. The experience of that company seems likely to mark a new epoch in lightning protection of transmission and distributing lines.

The Animas Power & Water Company's system comprises two 25-mile transmission lines operating at 43,500 volts and a distributing system of 60 miles of 17,000-volt lines supplying numerous mines. The two 25-mile transmission lines extend over different routes from the power house to a substation at Silverton. One of these routes is in the canyon and is not troubled much with lightning, but the other one on high ground was more likely to have trouble. The 17,000-volt lines reaching the various mines pass over rough, high, mountainous country and are much exposed to lightning. They serve about 100 sq. miles of territory. The altitude of the lines is from 9000 to 13,000 ft.

About 98 per cent of the shut-downs due to lightning were caused by the breaking down of transformer bushings where discharges jumped across. During the season of 1906 the General Electric 1905 multiplex type of lightning arrester was in use at the installations of several customers. The transmission line was operated at 50,000 volts delta-connected at first. It is now operated at 43,000 volts star-connected. No complete record was kept of lightning troubles for that season. In the season of 1907 there were three shut-downs in May caused by

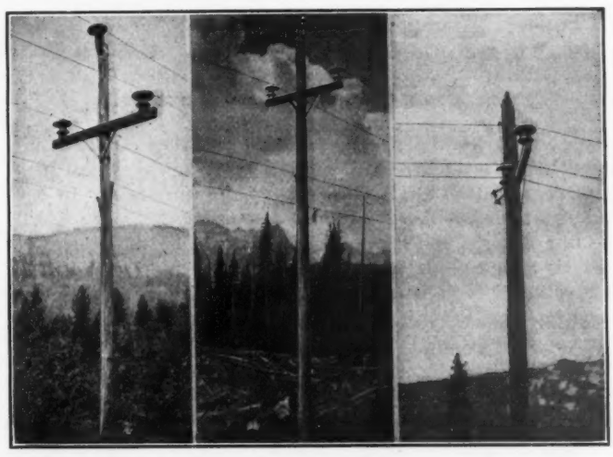
lightning, although the lightning season does not really begin until later at the higher altitudes.

During the lightning season of 1907 the number of storms was 34; storms causing complete shut-downs, 8; storms causing partial shut-downs, 17; storms causing no shut-downs, 9. From this the rather startling information is obtained that 73 per cent of all the storms caused a complete or partial interruption of service by lightning disturbances. While some of these disturbances caused an interruption of service of only a few seconds, they might mean a delay of a half-hour in the operation of the mills which the company supplies. There was no

FIG. 2.—17,000-VOLT LINE CROSSING DIVIDE.

evidence that the arresters installed were taking any discharges.

During the summer of 1907, Prof. E. E. F. Creighton and Mr. Peek, of the General Electric Company, spent some time studying lightning conditions on this system. During that time a number of aluminum cell arresters were put on the line and also some liquid arresters. The aluminum cell arrester was described by Prof. Creighton in these columns, issue of Aug. 15, 1908. The electrolytic arrester, which is not yet on the market, consists of a jar containing a liquid into which two terminals or electrodes extend a short distance, one electrode connecting to ground and the other to line. When a lightning discharge



FIGS. 3, 4 AND 5.—POLES.

passes through the jar, the liquid is blown away from the terminals and the circuit interrupted. This is a cheaper arrester to make than the aluminum cell and is therefore being experimented with for the protection of distributing lines. Nine jars are used per phase on the 17,000-volt lines.

During the season of 1908 there was only one shut-down on the system controlled by the company, though there was one on a branch line over which the company had no supervision of the lightning protection. Storms were frequent and tell-tale gaps used to keep a record of discharges showed that the arresters were operating every storm. In July there were 24 storms and in August 20 storms. The author said he felt that the company's lightning protection problem had been solved with the aluminum cell and liquid arresters, and that the one shut-down of the season was due rather to lack of arresters at certain points than to the failure of these types to do their duty. It should be added that the aluminum cell, besides being useful as a lightning arrester, is also valuable as an indicator of a ground on one phase.

The accompanying illustrations, which were among those presented with the paper, indicate the character of the country over which these transmission lines are built, and the appearance of the arrester equipment. Fig. 1 shows the 17,000-volt line at one of the high points near where storms are severe.

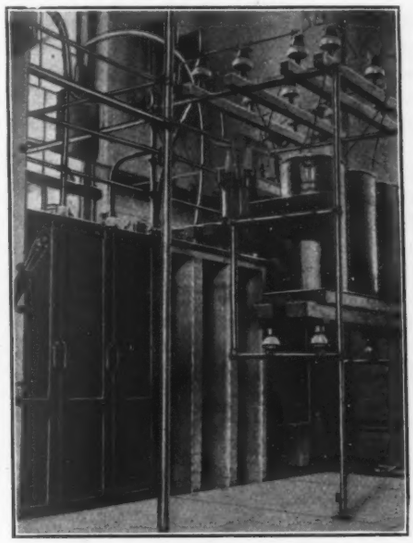


FIG. 6.—ALUMINUM CELL ARRESTERS.

Fig. 2 shows the same line near the crossing of a divide, showing the rugged character of the country. Fig. 3 shows the 43,500-volt line built of native poles. Fig. 4 shows the effect of lightning on a telephone pin on this same line. Fig. 5 shows the line with the top insulator broken by lightning and the wire resting on the cross-arm. The line was operated 24 hours in this condition. This was, of course, only possible because of the exceedingly dry mountain air which dries out poles and cross-arms after they have been in service for a time. Fig. 6 shows an installation of aluminum cell arresters at a substation. The aluminum cells are contained in the cans seen at the right.

Incandescent Lamp Leading-in Arrangement.

A patent issued Oct. 27 to Willis R. Whitney on an application dated Oct. 31, 1904, describes a means for obviating the use of platinum leading-in wires for incandescent lamps. The arrangement consists of two parts. One of these is a cylindrical shell of copper, brass or iron, provided with the usual external screw thread, which shell is sealed about the lower end of the lamp bulb, forming a tight and permanent joint therewith. In sealing the lower end of the glass bulb after insertion in the cylindrical shell, it is softened by heat, after which an air pressure is supplied so as to expand the glass into intimate contact with the metal shell. The shell has a higher coefficient of expansion than the glass, so that when the parts cool the metal contracts tightly about the glass, being made thin enough so that it will give as it comes under tension, thus preventing fracture of the bulb tube, which is considerably thicker than the rest of the bulb. The central portion of the shell is provided with a re-entrant tubular part into which is sealed a tube of glass, the outer end of which is closed by a metal cap sealed over the end of the tube in the manner before mentioned, and which projects beyond the level of the bottom of the shell. The filament of the lamp is connected electrically, one to the bottom of the shell and the other to the bottom of the cap, by a copper or other ordinary wire.

Successful Year of Electric Pumping at New Orleans.

The annual report of the New Orleans Sewerage and Water Board, just issued, shows that a successful year has been enjoyed in the operation of the extensive electric pumping equipment in that city, which installation has been described in these columns. There are now in New Orleans two steam-driven and one electric-driven pumping stations discharging sewage into the Mississippi River through force mains, and six intermediate electrically driven stations, lifting sewage from the low level to higher level sewers, all of which are now in operation or ready to receive connections. Additional pumping stations are needed to meet the growth of the city during 1909.

All the pumping stations, both the six automatic electric low-lift installations and the three high-lift plants, have been in continuous operation, and have each performed their work without any difficulty or serious complication. From this time forward the satisfactory operation of the system is only a question of proper maintenance and of the extension of the equipment as needed. The minimum possible number of electric and steam pumps were included in the original installation, with the intention of trying out the pumping system's novel and ordinary features. For this reason an early addition to the present equipment must be expected. At the central power station fuel oil was burned at a cost of $1.099 per barrel delivered. It is stated that the evaporation is ordinarily 15 lb. of water per pound of oil, and 1 lb. of oil being considered equal to 2 lb. of coal burned under average conditions, the fuel cost was equivalent to coal at $3.40 per ton. This comparison, however, appears to be unduly favorable to oil.

At the central power station the division wall between the engine and boiler room, which had shown signs of weakness, was taken down to the engine room floor and rebuilt with rich cement mortar. Heavy cast-iron plates were used as roof truss rests. All the steam piping has been gone over, new joints being made where necesary, and the pipe covering repaired. New furnaces were completed for the boilers, and general painting and repairs in the different stations were carried out. Some repairs have been made in the pumps, and at Stations 6 and 7 repairs have been made to the gas engines and producers, and at both stations the producers have been enclosed, so as to prevent the escape of coal dust and ashes into the station, as it was feared that the dust would injure the electrical apparatus. The transmission line is now being constantly overhauled, as most of the poles and cross-arms have been in service for nine years. A small force of men is now required for regular line maintenance in order to keep it in safe condition. These men are constantly renewing poles and cross-arms and adding new guys. As a further protection from lightning a number of the most modern type of lightning arresters have been installed along the lines, and others are yet to be placed. In May a cable burnout due to lightning occurred in a feeder to Station 1, but fortunately for the system, the location of the trouble permitted rapid repairs.

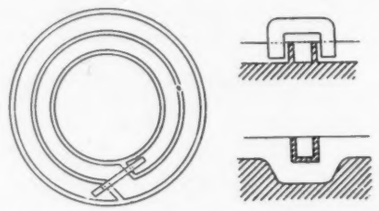
A new water pumping station of the electrically driven type is being installed in Algiers, and the bids for furnishing the machinery ranged from $25,884 to $33,259.

Electric Furnaces.

INDUCTION FURNACES.

A drawback found to exist in large electric induction furnaces resides in eddy-currents that are formed in the charge whereby the efficiency is considerably reduced. Fig. 1, which illustrates a furnace for which a United States patent was granted to Mr. Karl A. F. Hiorth, of Christiania, Norway, on June 2, shows a method of avoiding the eddy currents by giving the smelting chamber a spiral-like shape and by connecting the ends of the spiral by a conductor of solid material, as shown in Fig. 2, or of liquid, as indicated in Fig. 3.

The melting space in an induction furnace usually forms an annular crucible around a central iron core, the crucible being kept closed by a cover during the melting process. In order to overcome the disadvantage of employing a large number of sections to the cover, Mr. Otto Frick, of Stockholm, Sweden, has devised the arrangement shown in Figs. 4 and 5, for which a United States patent was issued on July 21. The cover for

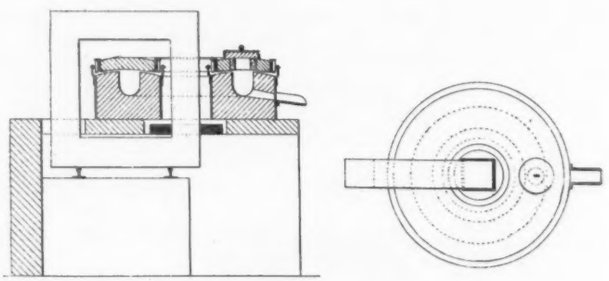


FIGS. 1, 2 AND 3.—HIORTH INDUCTION FURNACE.

the melting space is rotatably supported, so that it is possible to observe all parts of the melting space and to arrange the charge uniformly through a single opening. The furnace is rendered air-tight by means of sand seals between the movable and stationary parts.

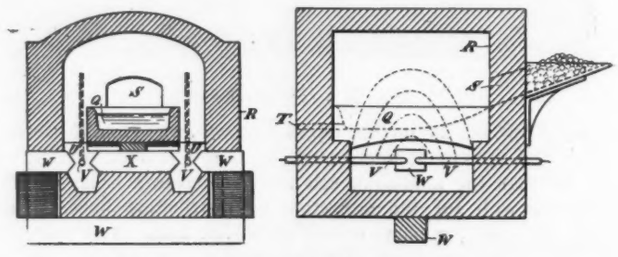
ARC FURNACE.

The arc furnace illustrated in Figs. 6 and 7 is one form of furnace patented by Messrs. K. Birkeland and S. Eyde, of Christiania, Norway, on June 2. The arrangement is such that the arc is deflected into a disk-shaped flame 3 ft. or 4 ft. in



FIGS. 4 AND 5.—FRICK INDUCTION FURNACE.

diameter, the electrodes being so placed that they cannot be injured by the handling of the material. A smelting hearth *Q* is arranged in the longitudinal axis of the furnace *R*. In one end of the furnace there is formed an opening *S* through which the raw material is fed into the furnace and in the other end there is a taphole *T*. On both sides of the hearth there is a free space *U* in each of which a pair of electrodes *V* is arranged so that a vertical or substantially vertical flame, as indicated with dotted lines, is formed. The magnet deflecting



FIGS. 6 AND 7.—BIRKLAND-EYDE ARC FURNACE.

system consists of the horseshoe-formed electromagnet *W* and a piece of iron *X* placed underneath the hearth. The current in the electrodes and in the magnet windings is so arranged as to cause the flame to be formed only on the top side of the electrodes. The flame will partly directly heat the sides of the hearth, partly radiate heat on the material on the hearth, and

partly create an upgoing stream of hot air, which will be reflected down on the material from the roof of the furnace.

INDUCTION FURNACE.

In the operation of induction furnaces it is found that the lining of the fusion chambers must be frequently repaired. It has been the custom to suspend operations for several days to allow the relining material to mature, harden and dry slowly; otherwise the walls crack and are soon destroyed. A United States patent issued Aug. 25 to Mr. J. Härden, of London, England, describes a furnace provided with a removable hearth

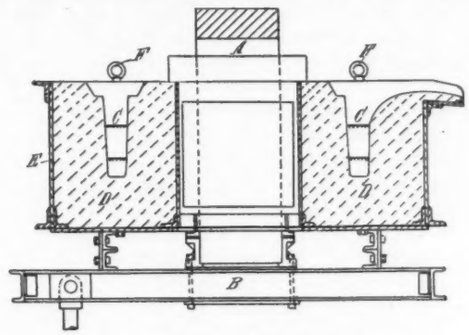


FIG. 8.—HARDEN INDUCTION FURNACE.

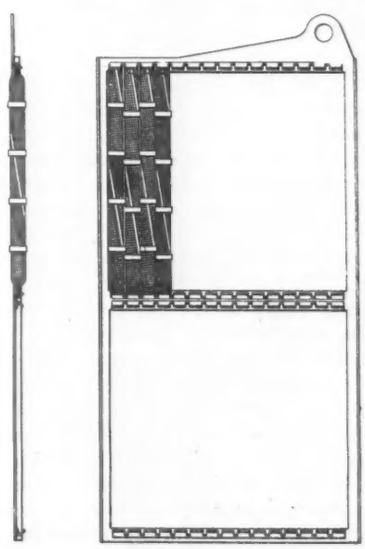
or lining so that when repairs become necessary the furnace charge may be run off into a ladle while a fresh hearth or lining is being substituted for the defective one. The arrangement proposed is illustrated in Fig. 8, where *A* is the iron transformer core and *B* is the framework upon which the furnace stands. *C* is the annular fusion chamber in which the charges are placed. The hearth or lining *D* is built in a metallic casing *E*, which is independent of the other parts of the furnace. The casing *E* is provided with lifting hooks *F* so that it, together with the hearth or lining *D*, can be lifted from the body of the furnace by means of a crane and a spare one put in its place without any appreciable delay, thus greatly increasing the working efficacy of the furnace and its auxiliary plant.

Improvements in the Edison Alkaline Storage Battery.

A patent issued Aug. 13 to Mr. Thomas A. Edison outlines methods for overcoming two difficulties encountered in the manufacture of thin films of nickel or cobalt used as an addition to the active material in the inventor's alkaline storage battery. Such films are made by electroplating a series of thin deposits on a suitable cathode, the films being separated by alternate deposits of a soluble metal which is dissolved later so as to free the nickel or cobalt films. The two difficulties encountered are as follows: In the first place, when the films are produced by electroplating they present smooth and relatively polished surfaces, to which the particles of active material, such as nickel hydroxid, are enabled to adhere with very little tenacity, even when the particles are compressed into contact with the films under enormous pressure. Consequently, when any internal movement of the active particles within the electrode mass takes place, such as may be due to the charging and discharging operations or to gas pressure, opportunity exists for the active particles to separate from the films so as thereby to deteriorate the contact conditions within the mass. In the second place, while under the perfect conditions of a laboratory experiment, nickel or cobalt, or other metallic films can be obtained which will be practically free of any impurity, yet, under commercial conditions where the films are to be made in large quantities, it is practically impossible to prevent the introduction of impurities which will do harm when used for battery work. The impurities principally encountered in this connection have been iron and arsenic, the presence of which tend to result in the formation on the surface of the films of oxids which injuriously affect the contact conditions within the mass.

Mr. Edison proposes to obtain the films by electrodeposition in the desired size for actual use. They are composed of metallic nickel. The films are now subjected to an operation by which an oxidation will take place, penetrating a very slight distance below the surface. This oxidation is effected by heating the films in an oxidizing atmosphere. The effect is not only to oxidize the surface particles of the metallic films, but also to oxidize the metallic impurities which may exist within the influence of the oxidizing effect, such as iron or arsenic. The films are now subjected to a reducing effect of hydrogen in the presence of heat, and the oxids are reduced to the metallic state. The films are now subjected to an acid treatment, which will have the effect of dissolving out any metallic impurity, which can be readily acted upon by reason of the previous oxidation and the consequent porous condition of the surface. For instance, when the impurity consists of arsenic the films are subjected to a dilute solution of nitric acid, and when the impurity consists of iron, the films are subjected to a dilute solution of hydrochloric acid; or if both impurities are present, the films are subjected to a mixture of nitric and hydrochloric acids in dilute solutions.

It is said that the treatment described does not objectionably affect the metallic nickel or cobalt surface of the films, since the iron or arsenic is much more soluble in the dilute acid than is the nickel or cobalt, which will be only slightly attacked. By thus oxidizing and then reducing the surfaces of the films, the shiny and polished effect is removed, and the films partake of a dull or matted appearance. Under the microscope, the surfaces thus treated appear to be pitted with innumerable excessively minute irregularities, the effect of which when the active material is tightly compressed into contact with the films, is to increase enormously the adhesion between them, so that when used in the make-up of a storage battery electrode, the intimate contact between the active particles and the films will always be maintained, notwithstanding internal movement. In other words, the effect is somewhat the same as the great adhesiveness of a label on a roughened glass surface, compared with its ready tendency to pull off of a smooth surface.



FIGS. 1 AND 2.—SIDE ELEVATION AND SECTION OF EDISON CELL.

The accompanying illustrations show an improved form of storage battery for which Mr. Edison obtained a patent on Aug. 25. Numerous pockets containing active material are secured to a conducting plate, the arrangement being such as to permit the ready removal of any pocket without disturbing the other pockets.

The grid shown consists of a thin plate of nickel-plated steel, stamped to provide one or more openings of rectangular form,

the upper and lower edges of which are formed with flanges having integral tongues corresponding in number to the number of pockets which are to be applied to the opening. The pockets shown are in the form of tubes of perforated metal filled with active material, the ends of the tubes being compressed or flattened, as shown, and the flanges in which the tongues are formed, are bent away from the opening, as shown in Fig. 1. When the tongues are at right-angles to the flanges, the pockets may be placed in position, and the tongues are then bent toward the flanges into the position shown in Fig. 1, thereby firmly securing the flattened ends of the tubular pockets and holding the same in conductive relation to the plate. Obviously, any one of the pockets may be removed from the grid by bending the upper and lower securing tongues which hold it, and a new pocket substituted therefor, the tongues being then bent back into holding position without disturbing any of the other pockets carried by the grid.

Hydro-Electric Development in Europe.

With regard to the development of water powers in Norway, U. S. Consul-General Henry Bordewich, of Christiania, says: Two Government bills were lately laid before the Storthing to the effect that the German company Badische Anilin und Sodafabrik shall be granted permission to acquire the Tyin and Matre water courses, in Bergensstift, West Norway, with the aim of developing the said water courses for a delivery of 60,000 to 70,000 hp. Among the conditions may be mentioned that the company is to pay yearly to the State 1 krone (26.8 cents) per hp beyond the 10,000 hp which the water course is supposed to supply in its natural state while undeveloped. The company is not allowed to raise the price of electric energy within this kingdom and is bound to supply 300 hp for public use at a yearly rate of 30 kroner. The work of development shall be commenced within five years and completed within 12 years; for the former period the company is permitted to employ foreign engineers and workmen to such extent as they deem necessary, although the ordinary conditions as to Norwegian employees and Norwegian material are laid down as the essential rule. After the expiration of 75 years both plants shall revert to the State.

The power in the Tyin district is derived by damming and regulating the water courses of the mountain lakes Mausbergvand, Torolmen and Tyin through the Tyin River. The other power is derived by regulating the water flowing from 20 smaller mountain lakes through Matre and Haugdals Rivers. The powers will be employed for the production of chemicals, for melting works for iron ore and for other industries. The plants when completed are calculated to cost about $12,000,000.

U. S. Consul J. I. Brittain, of Prague, states that in Austria anyone who may desire to use any public waterway for any purpose which may affect the quality of the water, or the quantity or height of same, or for any purpose causing injury to the banks of a stream, must first obtain a concession from the political authorities. For example, if the use is contemplated in the country, permission is obtained from the Bezirkshauptmannschaft and in the city of Prague from the City Council. Each concession must definitely specify the place where, and the quantity, also the manner in which the water is to be used. The water used must not in any manner impair the quantity necessary for fire protection, or irrigating or navigation purposes. Where the water is used for manufacturing purposes additional sanction must be given by the inspectors of workshops and factories.

The Government does not develop, sell or lease water power, such enterprises being carried out by corporations or individuals. The Government, however, endeavors to have the water power utilized as much as possible. There is no fixed rate charged for water power, as the price varies according to place and circumstances.

Several mills in Prague which have been run by water power will be obliged to resort to steam when the river Moldau is made navigable through the city. In Bohemia water power is principally used for running flour mills, paper mills, glass works, and electric-light plants.

In the mountain districts where there are numerous small streams the various industrial establishments are utilizing water power without any interference from the Government beyond the usual concessions for erecting the plants.

Swiss Water Powers.

In a recent consular report, Vice-Consul Leo J. Frankenthal, of Berne, gives an account of the progress being made to utilize the vast Alpine water power in Switzerland. Of a total of 1,000,000 hp within the confines of the Confederation, which contains but 16,000 square miles, 750,000 is capable of exploitation, while at present approximately 250,000 is utilized. In most of the cantons the cantonal government is deemed the owner of all public waters, lakes, rivers, streams, etc., where private rights have not been proved, but many small mills are run on private and sometimes on public waters, their rights being based on ancient servitudes. The cantons, and sometimes the communes, grant concessions for the use of water power, charging a certain rate for the concession as well as a graduated tax, according to the horse-power exploited.

Among the more important electric power houses run by water power are those of Brusio, Geneva, Rheinfelden, Kander-Hagneck, etc., many of which are owned and operated either direct by the cantonal governments or communes, or controlled by them through holding stock. The price of electric power generated by water varies according to the number of horse-power and length of time used. A favorite method is that of paying a fixed yearly sum for 3000 to 3300 hours, and factories make contracts with the power houses varying in prices paid from $21 up to $65. Where a meter is used, the price is charged per kw-hour, the minimum being about 1.8 cents. Each power house has its own scale of charges.

The manner of granting concessions is well shown by the most recent legislation on the utilization of water power, that of the Canton Berne. Many of the cantons have laws more lax, but none is more severe. Following are its main provisions:

The canton controls the water power and grants concessions, and if the public interest demands it, water power will be utilized direct by the government. No grant may be injurious to the public interest, nor may natural beauties be disfigured. When a concession covering the same project is requested by several different parties, that which best provides for the public good must be granted. The communes are entitled to request concessions, and, all things being equal, they will take precedence over private persons. Plans, details, etc., are public, and the concession seeker must pay all costs of government investigation, while bonds to cover eventual damages to property may be demanded. The concession fee is divided into three classes, and these are determined by the size, length, location of works, cost, difficulty of construction, etc. Class I, $0.60; Class II, $1; Class III, $1.60 per each horse-power conceded.

In addition to the concession fee, all works of more than 10 hp must pay a yearly impost on each (average) horse-power used during the year, namely: $0.20 up to concessions not exceeding 100 hp; $0.40 for concessions from 101 to 500 hp, and $0.60 for concessions over 500 hp. Reduction of this impost is granted during non-usage, low water, etc. The impost is collected by the canton and 10 per cent thereof is set aside to provide a relief fund in the event of damages by natural causes, avalanches, landslips, washouts, etc. This fund must not form a part of the cantonal assets. Concessions granted to communes or to companies or associations whose entire stock is owned by communes, the canton, or both, are not limited in time.

Other concessions are limited to 50 years, after which the concession reverts to the canton, and it may then determine whether it will continue the works or renew the concession for a period of 25 years, after the expiration of which it may again

be renewed for another 25 years, making 100 in all. If the canton does not renew the concession after its first expiration, the actual value of the works, including land and machines, must be paid. After the 100 years has elapsed, the canton is obliged to pay only for the value of the land upon which the buildings stand. It is not forced to take over the machines, but if it does so, their value must be refunded.

Concessions are declared null and void (1) if the holders do not commence actual work on the buildings, etc., within three years or complete same and place them in running order within the time specified in the concessions; (2) if the works remain idle for five consecutive years; (3) if the stipulations of the concessions are not followed after warning has been given, and (4) if the works are turned over to third parties contrary to law. The permission of the authorities is requisite to deed the property to any other waterworks, and such permission may be coupled with further conditions and restrictions. The canton may purchase the works at any time. A water register is kept and all details regarding concessions, waterworks, statistics, etc., are entered therein.

Companies must also pay yearly taxes the same as any citizen or business house, and these cover property tax and income tax. Each horse-power is deemed "property," and a valuation is placed upon it varying from $180 per horse-power used for subsequent transmission to $300 for each horse-power for direct use.

For a number of years interested parties and associations, among which the society Free-land may be mentioned, have been striving to secure uniformity on the subject of water-power legislation, a matter upon which it is difficult to reach an agreement on account of the conflicting cantonal regulations and diversified interests. Switzerland, as a mountainous country, possesses such a wealth of water power, so comparatively easy of utilization, that it amounts to a national fortune, particularly when the fact is considered that the country is dependent upon foreign lands for its coal, imported to the extent of 3,000,000 tons yearly. The main railroads are owned and operated by the federal government, and a permanent commission is engaged in studying the question of their electrification. Whenever this conversion is accomplished—and it will be many years before the change is completed—the government must be assured of sufficient water power to generate the electricity for their use.

Protection of the streams is also important to the domestic industry which is dependent upon the foreign markets. In 1906 the government took a decisive step. Drawing attention to the immense sums that had been expended in the past for the correction of lakes and rivers and to the vital importance of Switzerland being secure in the possession of its water power, it obtained from Congress the passage of a resolution providing that the transmission into foreign countries of electric energy generated by domestic water power must be dependent upon a permit granted by the Federal Council. This was directed against the boundary cantons, some of which had granted liberal concessions for the sale of power to foreign countries, particularly Italy.

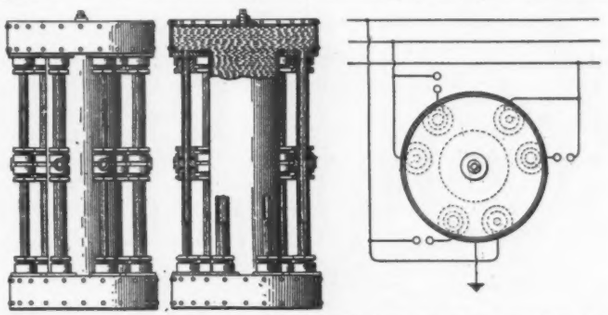
The resolution provides further that permission will be granted if the power is not required in Switzerland, that permits shall be for a period not exceeding 20 years, that they may be revoked if necessitated by the public good, and damages resulting shall be decided by the Supreme Court. It was dated March 31, 1906, and is to remain in force for three years (until March 31, 1909). This resolution was not styled a law, but designated as urgent, and passed by Congress without the referendum clause. There was added to it a postulate inviting the Federal Council to investigate the question of protecting the interests of Switzerland with regard to water power in general by means of constitutional amendment or otherwise.

In the meantime the adherents of unity in water-power legislation were not idle. In order to hasten matters, an initiative was prepared and 95,000 signatures, or 45,000 more than the necessary 50,000, were secured. It demanded an amendment to the Swiss constitution placing the utilization of the water power under the control of the federal government, and providing that subsequent regulations be made concerning the rational exploitation of the intercantonal and boundary waters, the correction of insufficient cantonal legislation (normal concession), the rights of the Confederation as owner of the main railways and the protection of the public interests in general; concessions to be granted by the cantons as heretofore with the exception of those concerning intercantonal or boundary waters when the federal government is empowered to act; taxes, fees, etc., to be retained by the cantons; the permission of the federal government for the transmission of energy into foreign countries; subsequent legislation to cover present concessions unless contrarily stipulated. This amendment was withdrawn in favor of the Federal Council's substitute amendment, which was adopted at the Federal elections held Oct. 25, 1908. In the last few years the federal government has made several contracts with the cantons in order to secure water power for its own use. The acceptance of the amendment by a majority of the votors and cantons adds to the centralization which took a wide step forward with the passage of the new civil code destined in 1912 to supersede the varied cantonal laws.

Lightning Arresters.

LIQUID-RESISTOR LIGHTNING ARRESTER.

The lightning arrester illustrated in Figs. 1, 2 and 3 is of the combined shunted-resistance and spark-gap type. It consists of resistors of high resistance connected directly from line to ground and resistors of low resistance joined in series with



FIGS. 1, 2 AND 3.—ELEVATION, SECTION AND DIAGRAM OF APT ARRESTER.

spark-gaps across the circuit to ground. Each resistor is a column of water contained in a glass tube, the resistance depending upon the cross-sectional area of the water-column.

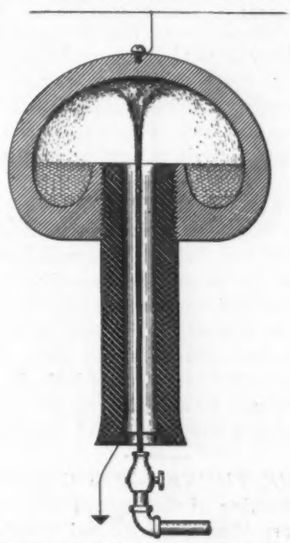


FIG. 4.—MERRIAM LIGHTNING ARRESTER.

Each tube is in two sections connected together by a metal coupling which is in contact with the water and serves as an electrode for establishing connection between the water and the

conductor to be protected. The ends of the tubes are held in grounded cylindrical tanks, which are interconnected hydraulically by a standpipe. On account of the heating action of the current in the shunted resistors, there is a continual circulation of water upward through the tubes and downward through the standpipe. A United States patent covering this arrester was issued to Mr. Richard Apt, of Berlin, Germany, on June 16.

WATER-JET LIGHTNING ARRESTER.

Fig. 4 shows a type of arrester for which a patent was issued to Mr. E. B. Merriam on June 19. The terminals consist of a metal shell at the top and a metal ring at the lower end of an insulating tube of vulcanized rubber. A jet of water is directed upward from a grounded nozzle in such a way that it passes centrally through the opening in the insulating tube and impinges against the top of the cavity within the metal shell and is there deflected downward into the annular trough disposed within that shell. From this trough the water overflows through the insulating tube and comes in contact with the lower metal ring. Any heavy discharge passing to earth through the water traversing the constricted chamber of the insulating tube will vaporize the water and develop a high vapor pressure within the shell, this action being in the nature of an explosion or high velocity blast to drive the arc downward through the tube and thereby rupture the arc. The inventor claims that the circuit opens at the zero point of the current wave and consequently does not produce oscillations on the line as might be the case with an uninclosed water jet.

CURRENT NEWS AND NOTES.

CENTRAL STATION AS FORESTER.—The Brockton (Mass.) Electric Light Company is planting a small forest of chestnut trees in order to supply its needs in the far future.

NEWPORT WIRELESS PLANT.—The Navy Department has asked for bids for constructing at the naval torpedo station at Newport, R. I., a wireless telegraph plant, to have a radius of 1250 miles. The building now being erected for the plant will cost $40,000.

BREMERTON NAVY-YARD ELECTRIC PLANT.—A central electric generating plant will be installed in a building 125 ft. x 25 ft. Two water-tube boilers, with superheaters and oil-burning furnaces, will furnish steam to two 1000-kw turbo-generators. At present there are several generating plants scattered about the yard, aggregating about 1000 hp.

ELECTROTECHNICAL COMMISSION.—Cable dispatches state that Prof. Elihu Thomson has been unanimously elected president of the International Electrotechnical Commission sitting in London. The probability of this action was noted in these columns recently. Professor Thomson is in hearty sympathy with the aims and ends of the commission, but, we learn, is still in this country, awaiting further details.

TELEPHONE TOLLS ON TELEGRAPH MESSAGES.—The New Orleans Telephone Company has made a demand on the Western Union and Postal Telegraph Companies for 15 per cent of the tolls on messages delivered to city addresses by telephone. The telegraph companies maintained, however, that they are entitled to use their telephone instruments for any legitimate purpose, and refused to pay more for service than any other subscriber. It is stated that both the telegraph companies at Chattanooga, Tenn., ordered the telephone instruments taken out when a similar demand was made there.

THE ST. CLAIR TUNNEL.—The Grand Trunk Railway announces the completion of the electrification of the St. Clair tunnel between Port Huron, Mich., and Sarnia, Canada, and will celebrate the occasion on Thursday, Nov. 12, when the electrical plant, equipment and appliances will be thrown open for inspection. A special train will leave the Grand Trunk station at 1 p. m. for a trip through the tunnel under electric power. The tunnel is one of the longest submarine tunnels in the world, and about $500,000 has been spent in making the change from steam to electricity. A large gathering is expected.

PATENT MODELS.—There has been a good deal of discussion as to the fate of the 157,000 models that were accumulated by the United States Patent Office up to 1880, when mechanical drawings were held to be sufficient. It is now stated that the entire collection has been cataloged and labeled and that it will shortly be lodged in the new National Museum Building, where the law directs that these models shall be lodged under the control of the Commissioner of Patents. A great many interesting electrical models are in the collection. They were shown at the Philadelphia Electrical Exhibition in part in 1884; at Chicago in 1893, and at the New York Electrical Show of 1896.

MORE POWER-HOUSE LAND IN CHICAGO.—The Commonwealth Edison Company, of Chicago, has obtained control by lease, of land amounting to almost three acres at the southeast corner of Quarry Street and the Chicago River, across the street from its new Quarry Street station. The company is thus anticipating by a number of years its power-station and coal-storage requirements. The recent contract to supply power to the Chicago City Railway for a period of 10 years, with the probability that it will also supply electrical energy in large quantities to other street and elevated railway companies and to the Chicago steam railroad terminals, makes advisable very extensive provisions for growth of power-plant capacity.

WESTERN SOCIETY HOUSE WARMING.—The Western Society of Engineers had a smoker and house warming for the formal opening of its new quarters on the seventeenth floor of the Monadnock Building, Chicago, Oct. 29, 1908. A number of past presidents of the society spoke. Among them were Mr. W. L. Abbott, of the Commonwealth Edison Company, Chicago, and Mr. Bion J. Arnold. The society has now been in existence 39 years. The present membership is over 1000. It is calculated by the officers that at the present rate of increase even the new quarters will soon be outgrown. The new audience room, which is a great improvement over the one formerly used, has efficient provisions for ventilation, and is protected by surrounding offices from street noises, which were formerly annoying. The lighting of the audience room for ordinary purposes of meetings is accomplished by a semi-concealed system, in which lamps with reflectors are placed above the skylight, and the direct light sources are almost entirely screened from the eyes of those in the audience.

PATENT OFFICE FIGURES.—The annual report of Hon. E. B. Moore, United States Commissioner of Patents, just issued, shows that there were received in the last fiscal year 58,527 applications for mechanical patents, 1091 applications for designs, 207 applications for reissues, 2036 caveats, 7467 applications for trade marks, 810 applications for labels and 339 applications for prints. There were 34,902 patents granted, including reissues and designs, and 6135 trade marks, 636 labels and 279 prints were registered. The number of patents that expired during the year was 24,270. The number of allowed applications which, by operation of law, were forfeited for nonpayment of final fees was 6520. The total receipts of the office were $1,874,180 and the expenditures $1,608,292, leaving a surplus for the year of $265,888. A new division, of "Classification," is proposed, whose duty it shall be to classify all patents and digest technical publications relating to patents. The rate for assignment has been raised by the law of last May to $1 for each paper containing 300 words or less, $2 for each paper up to 1000 words, and $1 for each additional 1000 or fraction thereof. The price for patent specifications is now 5 cents a copy for all patents. As already noted in this column, the patent models are to go to the new National Museum in Washington. A new building for the Patent Office, to be paid for out of the surplus earned, is strongly urged.

Illumination of Seventh Avenue, Manhattan Borough, New York City.

THE illumination of Seventh Avenue north of Central Park to its terminus at Central Bridge, a distance of over two miles, is a practical demonstration of the value of considering in advance the local requirements of the thoroughfare to be lighted, and of selecting the form of illumination that would best fit the local conditions. This avenue extends through a congested residential district in which the modern fireproof apartment houses with retail stores on the street level predominate, and is in reality a boulevard 150 ft. wide, with a 10-ft. strip of parkway through the center forming two separate roadways. Shade trees of mature growth are planted at the sidewalk curb line, the foliage overhanging both roadway and walk.

The selection of the form of illumination that would best answer the local requirements—residential and retail shops—and best facilitate travel on the streets and make transportation as safe at night for horse-drawn and high-speed motor-driven vehicles as during the day, made it imperative that the form of illuminant and the arrangement of the lighting units should be chosen only after careful investigation.

FIG. 1.—GENERAL VIEW OF SEVENTH AVENUE AT NIGHT, LOOKING NORTH.

The lighting of public thoroughfares in the City of New York is under the jurisdiction of the Department of Water Supply, Gas and Electricity, Hon. John H. O'Brien, commissioner, and is in direct charge of Mr. C. F. Lacombe, chief engineer of light and power. The initiative and progressiveness of these gentlemen have made possible the lighting of a city street that compares favorably with the best practice abroad and forms a standard for future work of this kind in this country. In connection with this installation there has been designed a special arc lamp post decorative in itself, and one which satisfies the practical requirements of this boulevard in particular.

Exhaustive tests, extending over many months, in which consideration was given to all forms of illuminants—Welsbach gas lamps, incandescent electric lamps and clusters, and arc lamps—were conducted under Chief Engineer Lacombe's direction in cooperation with the electric light companies of Manhattan. Actual installations were made on representative streets under New York traffic conditions, and when completed were tested, as installed, by the Electrical Testing Laboratories, whose reports served as a basis of comparison. In the course of the tests it became apparent that the candle-power measurements at the street surface should not alone be used as a determining factor, but that consideration should also be given to the effective vertical illumination obtained at varying heights, the absence of shadows or bright spots, and of the effect on the thoroughfare as a whole.

Arc lamps, with their large volume of light, have a decided advantage in this respect, and with the advantages of installation, were finally decided on as the best form of illuminant for a city street of the character of Seventh Avenue. The location of the arc lamps was considered with a view to securing as even a distribution of light on the street surface as it was possible to obtain with the necessarily arbitrary location of arc lamps at the important street intersections. As the results of the tests the mast-arm type of post was selected for the tree-lined sidewalks, and the lyre type of posts for the parkway center of the street. An outer globe of a very light opal glass with a clear inner arc-enclosing globe was decided on, as affording the best diffusion and correction as to color without too large a sacrifice of illuminating efficiency. The outer globe is special and is known to glass makers as "a cased globe," i. e., a thin film of opal glass molded over an inner wall of clear glass. The distribution with this combination is shown in Fig. 14. Fig. 12 shows the shadows with a lamp equipped with clear inner and clear outer globes and Fig. 13 shows the distribution from a lamp with an alabaster inner and a clear outer globe.

From the standpoint of illumination this installation is of particular interest on account of the exceptionally even distribution of light over the entire surface of the roadway and sidewalks, and on account of the good diffusion which has resulted in the practical elimination of shadows and bright spots. While the intrinsic brilliancy of the arc lamp has been somewhat reduced by the substitution of opal outer globes for the usual clear globes, the even diffusion, absence of heavy shadows and bright spots more than compensate for any loss in actual effi-

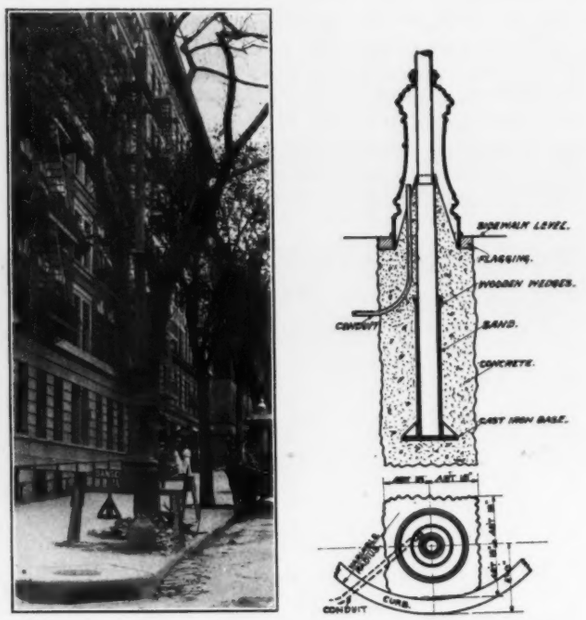
ciency. The elevation of the arc lamps 22 ft. above the road, and their adequate number, provides an illumination of the foliage and secures a reflection from the surrounding buildings, giving an effect of general brilliancy of illumination which is quite independent of the specific horizontal illumination obtained, and which would not be possible with any number of smaller units closer to the plane of the street surface. The placing of either gas or electric incandescent single units, or clusters, on standards less than 12 ft. in height, although installed close together, would not alter these conditions, although the horizontal candle-foot measurements would be greatly increased. The lamps in this installation average 58 to the mile—over 26 kw per mile—and are placed one each 15 ft. north and south on diagonally opposite corners of intersecting streets and one to the block in the center of the parkway dividing the roadway, thus making three lamps to the block, but obtaining the effect of five lamps per block. The distance between the lamps at the intersecting streets is 80 ft., and there is 110 ft. between the lamp at the intersecting street and center of the parkway lamp. A test made to determine the intensity of illumination produced by the lamps spaced as above indicated, in comparison with Welsbach mantle gas lamps gave results as shown in the following table, and in Figs. 10 and 11. The figures given are for the illumination produced upon a horizontal plane, approximately 4 ft. 8 in. above the street surface:

	60-cp "horizontal measurements with the globe removed." Welsbach mantle gas lamps. Clear globes.	450-watt enclosed arc lamps. Clear inner and opal outer globes.
	Foot candles.	
Maximum	0.701	0.688
Minimum	.001*	.010
Average	.028	.084

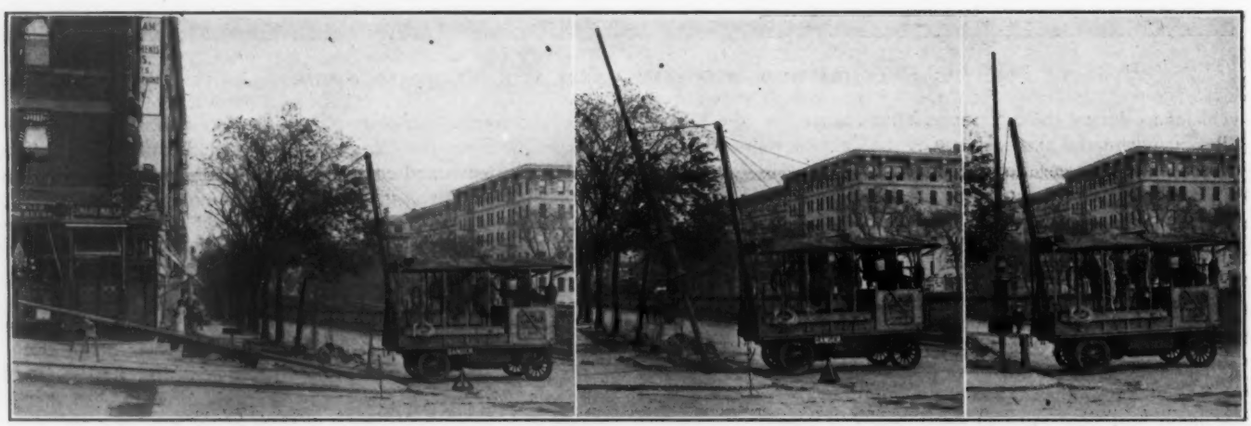
*Approximate—too low for accurate measurements.

Particular attention is invited to the very even distribution of light from the arc lamps, the ratio of the average illumination to both the maximum and minimum being as 8 to 1, while the similar ratio for gas lamps is 25 to 1, indicating in the latter high and low extremes or isolated zone lighting; in other words, shadows and bright spots. Further reference to these comparisons will show that the ratio of the average value in candle-feet of the arc lamps as compared with gas is 3 to 1, and this all without reference to the vertical illumination so valuable to a city street. In view of the above comparisons it is doubtful if the new form of illumination in which cluster incandescent lamps are used for street lighting, is, after all, superior to arc lamps for effective distribution.

FIG. 2.—TOWER WAGON USED IN TRIMMING LAMPS.



FIGS. 6 AND 7.—DETAILS OF CONCRETE CONSTRUCTION AT BASE OF LAMP POST.



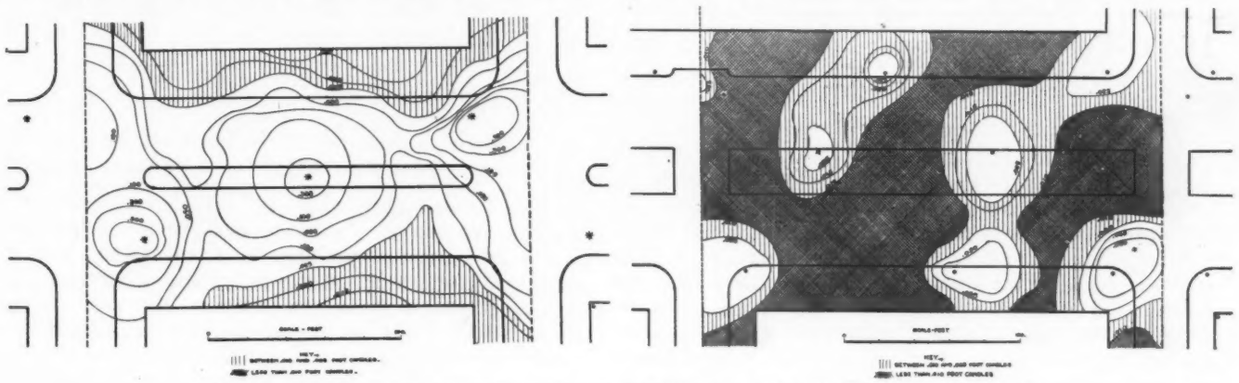
FIGS. 3, 4 AND 5.—METHOD OF ERECTING LAMP POST.

Both types of post are special to this installation, and represent in their construction and design a departure from the standard forms of arc lamp posts. The general design of the posts

has been the subject of careful consideration, and they have been evolved after a study of the best designs in use in European cities.

FIGS. 8 AND 9.—VIEW OF SEVENTH AVENUE BY DAY AND BY NIGHT.

The mast-arm post has for its sustaining member a steel tubular shaft of four sections swedge jointed, and is 37 ft. over all. The two-piece 12-ft. extension arm is of similar construction, and over both are applied, in the form of slip castings, the iron sections that go to make up the ornamental design of the post, the whole weighing approximately 2000 lb. The usual unsightly loose wires, ropes and devices for lowering arc lamps have been dispensed with, and the lamp incorporated in the design of the post itself, suspended from a concealed hanger. The steel sustaining member and arm can be reduced with a pipe cutter when the post is in place, or shaped before installation, and make possible a post of flexible proportions, and one that can be fitted to a selected location regardless of the over-hanging tree limbs and without detriment to them, thus enabling the locating of the lamp at the most desirable place. The cast-iron ornamentation has been designed to adapt itself to extensive changes, either in the shaft or arm, and to conform to them irrespective of change in their length, height or shape. An equipment of this character has made necessary the preparation of a special foundation, and has also required special appliances and methods in the handling of the posts, as shown in the accompanying



FIGS. 10 AND 11.—ILLUMINATION CURVES OF ELECTRIC ARC AND INCANDESCENT GAS LAMPS.

FIGS. 12, 13 AND 14.—EFFECT OF GLASSWARE ON THE DISTRIBUTION OF LIGHT.

photographs. In the special foundation of concrete is included, at the time of its building, a collapsible core box, paper wrapped and plumbed, which is knocked down and removed after the mass solidifies, leaving a clear entrance, with a slight increase for the shaft, through the concrete to a cast-iron receiving flange at the bottom. The various operations in raising and assembling the post in position, with the aid of the boom and the automobile and electric winch, are also illustrated in the accompanying photographs.

The lyre type of post installed in the narrow parkway dividing the roadway is 27 ft. in height, but is not of as massive proportions as the mast-arm post, and differs in that it is entirely of cast iron and in three sections. A fluted, wreath-entwined Corinthian column, fitting into a concealed ground joint at the top of a base of suitable design, is surmounted by a section of ornamental cast and wrought iron, patterned after a lyre, in the center of which the lamp is suspended. The design of the lyre is complete only with the lamp and is of such proportions that it cuts off no light. No direction is given the lamp at its point of suspension and its location in the center of the parkway is of great advantage in that it has a distribution unaffected at any angle by intervening obstructions.

Both types of lamp equipment will be trimmed from the tower wagon shown in Fig. 2 and can be most effectively handled in this manner, a single trimmer under these conditions trimming at least 150 lamps in a day. The lamp posts have been furnished by the lighting companies supplying the service—New York Edison Company and United Electric Light & Power Company—with whom will also rest the maintenance of the equipment.

Direct-Current Motors, Their Action and Control—XI.

By F. B. Crocker and M. Arendt.

Series-Parallel Control.—When two or more series motors are employed to operate the same car, hoist or similar apparatus, or when two or more armature windings are on the same core, series-parallel control is possible. By this method the two or more motors (or armature windings) are connected in series at starting and for the low speeds, so that much less external resistance is required than with rheostat alone. The resistance is gradually decreased until each motor consumes one-half the line voltage. For higher speeds the two motors are connected in parallel with the external rheostat again introduced in series, the resistance being gradually reduced until each motor receives the full line voltage. The various steps of series-parallel control are shown in Fig. 1. Two highly efficient running points are obtained, one at half voltage and the other at full voltage; that is, with the simple series and parallel connections of the two motors without external resistance. The introduction of more or less external resistance is to enable the transition from one speed to another. Evidently, the connections indicated at *c* and *j* in Fig. 1 include only a small external resistance with correspondingly small loss of energy and decrease in efficiency.

CONSTANT-CURRENT SERIES MOTORS.

Although not used commercially at present, this type is of such historical importance, and differs so radically from the constant-potential motors now universally adopted, that it deserves some attention. Electric motors were first used in considerable numbers about 1886 or 1887. Then, and for some time afterward, there were constant-current arc lighting circuits in many smaller towns and in portions of large towns where constant-potential supply was not available. In such cases motors were operated on these circuits in series with arc lamps. The connections are represented in Fig. 2, *A* being the armature and *F* the field circuit of such a motor, the windings of which were designed to carry the constant current (usually 10 amp) continuously. Hence, no starting box was required, the motor being introduced directly into the circuit by the cut-out switch *S*.

A plain series motor with constant current exerts constant torque (at full value), because $T = K\phi I$, in which field flux ϕ and armature current I are both constant. Unless the load happens to equal this torque some means for adjusting the motor torque to the load must be provided, otherwise the motor will either stop or race. The usual method was to short-circuit more or less of the field winding, or to shunt it with variable resistance by means of a switch controlled by a centrifugal governor mounted on the motor shaft. A diminution in load below the motor torque would produce a rise in speed, and the governor would then reduce the field strength and torque to the proper value. Shifting the brushes or moving the armature out of the

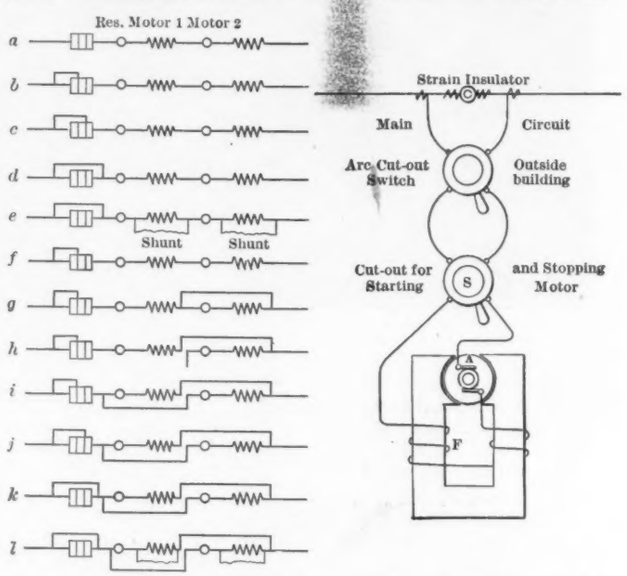


FIG. 1.—SERIES-PARALLEL CONTROL OF TWO-SERIES MOTORS. FIG. 2. —CONNECTIONS FOR CONSTANT-CURRENT SERIES MOTOR.

field were other methods employed to regulate the speed of constant-current motors. The serious objection to the operation of motors on constant current series circuits is the high e. m. f. of the latter, usually from 3000 to 6000 volts. Even the potential difference between the motor terminals is about 100 volts (1000 watts ÷ 10 amp) per horse-power, which would amount to 1000 volts for a 10-hp machine. All of this except 30 or 40 volts drop in the field winding (IR_{se}) would exist as a potential difference between the brushes, being dangerous to persons and high for commutation. To supply 50 hp to a factory by this system would involve a potential difference of 5000 volts between the two conductors whether using one motor or several in series. The constant-current motor, however, possesses the great advantage that the armature may be stopped indefinitely with full current flowing and no injury results. In fact, its temperature is practically the same as at the rated speed, because the absence of armature core losses when standing still usually makes up for decreased ventilation.

COMPOUND-WOUND MOTORS.

There are two classes of compound-wound motors. In one case the ampere-turns of the series coil reinforce the shunt field ampere-turns, producing the cumulative-compound motor; in the second case the series ampere-turns oppose the shunt, producing the differential-compound motor. The former machine is commercially called the compound motor, the latter being known as the differential motor. The connections of a compound-wound motor are shown in Fig. 3.

As already noted, an ordinary shunt motor is usually operated with constant potential at the field circuit terminals, so that the flux is practically constant at all loads (except for a slight effect of armature reaction which reduces this flux by a small percentage at rated armature current and torque). Hence the torque increases practically in direct proportion to the armature current. In a cumulative-compound motor the conditions are somewhat different,

since the field becomes stronger with increase in load, due to the magnetizing action of the series coil, so that the torque increases more rapidly than the armature current. That is, the torque is proportional to the armature current and to the field flux (due to the sum of the series and shunt excitations), that is $Torque = KI_a\ (F\frac{V}{R_{sh}} + FI_a)$. At the same time since the field flux rises with increase in the load, the speed decreases, due not only to I_aR_a effects, but to the relation $r.\ p.\ m. = \frac{e60\,10^8 b}{n\phi 2p}$. This decrease in speed becomes relatively less as the load increases, because the field flux rises less rapidly as the magnetic density approaches saturation; further reduction in speed is caused solely by the armature and series field IR drop. Hence, the compound motor combines the characteristics of the shunt and the series types, having a speed not extremely variable under load changes, but developing a powerful starting torque. The stronger the shunt field flux (no-load flux) the more nearly the action corresponds to that of the shunt motor; the weaker the shunt field the more closely does the machine resemble the series motor. In fact, two forms of cumulative-compound wound motors are manufactured, one with a low ratio of series field m. m. f. to shunt field m. m. f. varying from 12 to 50 per cent at rated load; the other having a series m. m. f. equal to 75 or 90 per cent of the shunt field

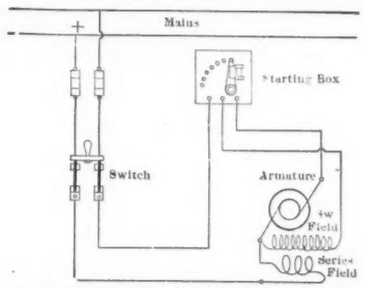


FIG. 3.—CONNECTIONS OF COMPOUND-WOUND MOTOR.

m. m. f. The former machines are employed extensively in shop practice, where a motor may be required to start under heavy load, but must maintain an approximately constant speed after starting, or when the load is removed. The heavily compounded motor is employed where powerful starting torque and resulting rapid acceleration are necessary with a speed not too widely variable under changes in load corresponding to the requirements of elevator, hoist and similar service. In addition to the comparatively constant speed required after running speed has been attained, elevator service demands a further condition, namely, the motor must have the series field winding cut out or short-circuited at the full speed to avoid the reversal of the machine should the elevator be heavily overbalanced. This would cause the motor to speed up, and if the series winding is relatively powerful, compared with the shunt winding, it would reverse the excitation and result in a burn-out. Well-designed shunt motors have a speed regulation within 5 per cent; series motors have a speed change of almost unlimited ratio from no-load to full-load or *vice versa*, while compound-wound motors have speed variation from 12 to 100 per cent above that corresponding to the rated torque, depending upon the ratio of shunt to series field m. m. f.

The speed control employed with compound motors may be by any of the various methods explained in connection with the shunt motor, though when used for elevator service the control is entirely rheostatic with the final cutting out of the series winding.

The Differential Motor.—In this class of compound-wound motor the m. m. f. of the series winding opposes that of the shunt winding and thus weakens the field with increase of load. The object of this is to compensate for I_aR_a drop and thus to maintain the speed constant at all loads. These machines will operate satisfactorily if not overloaded, but if an overload occurs, the field flux becomes so much reduced that the torque is not sufficient to maintain rotation, hence the c. e. m. f. falls to zero and a burn-out of the armature winding results, unless the machine is protected by fuses or a circuit breaker. A still further objection to this motor is the impossibility of obtaining a powerful starting torque on account of the weakening of the field with heavy currents; in fact, since the series circuit is of considerably lower inductance than the shunt circuit, the motor if suddenly started under load would tend to rotate in the wrong direction. Hence the series winding should be automatically short-circuited while starting the machine.

The same regulation as that secured by differential winding is obtained from a specially designed shunt motor with armature reaction exaggerated, by brush lag, by an excessive number of armature turns, or by proper use of interpoles, without the serious weakness of the differential motor. For most practical purposes, however, the speed of the plain shunt motor does not vary to an extent that is objectionable, so that special regulation is not needed. The differential is, therefore, rarely used.

RESUMÉ OF CHARACTERISTICS OF DIRECT-CURRENT MOTORS.

Shunt motors have a speed varying only slightly with load changes, and good starting torque. They are employed where the speed should be approximately constant and also where the speed may be varied by some of the methods described.

Series Motors.—These machines are employed when powerful starting torque and rapid acceleration are demanded, also when speed must be automatically adjusted to load.

Compound-wound Motors have a speed decreasing considerably (12 to 50 per cent) with load, but possess the powerful starting torque characteristic of series motors, and are employed in connection with work requiring powerful starting effort, but a speed not excessively variable under load changes. They may be safely belted to the tool, while series motors should never be, but must be positively connected.

Differential motors may be designed to give an almost absolutely constant speed under all load changes within their rating, but beyond this the motor is too likely to be stalled; the starting torque is also small. This motor is no longer used in practice, improvements in the design of shunt motors having secured nearly constant speed without the objectionable features of the differential type.

Carbon Brushes for Motors.

The committee on maintenance and inspection of electrical equipment recommends in its report to the American Street & Interurban Railway Engineering Association a general classification of motor brushes, together with certain specifications and tests. While it is appreciated that there are very many motor brushes, their separation into three general classes is thought to cover all. The classification recommended divides these into brushes of coke, part coke and part graphite, and graphite, employed as follows:

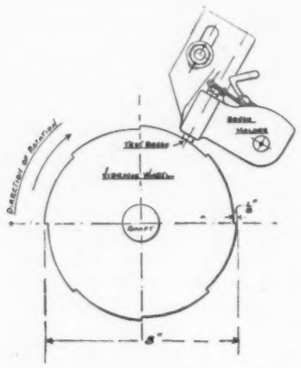
Coke brushes are generally suitable for railway motors of approximately 50 hp and less, with ungrooved commutators operating on low-speed service, such as city service, switching locomotives, air compressors or other service where the abrasive and polishing quality of the brush is necessary. The composition of the brush is mainly coke.

Part coke and part graphite brushes are generally suitable for motors of 50 to 100 hp in interurban and suburban service and normally used with grooved commutators. Should the commutator require only a moderate amount of abrasive effect to keep polished these brushes may operate on the above sizes of motors without the side mica being grooved. Since a commutator having grooved side mica requires less polishing effect, this brush may be used to considerable advantage on motors of less than 50 hp in city or low-speed service, provided the commutators are grooved.

Graphite brushes are suitable for general use on grooved commutators and on motors of 100 hp and over. The graphite brush inherently has a large lubrication nature and has the power of carrying a large current per square inch. The lubricating quality of the graphite brush serves to reduce or obviate chattering and constant break-

age of brushes. The abrasive effect of graphite brushes is generally low, and it does not have the power to polish the commutator and wear away the side mica and therefore should be used only on commutators with grooved side mica. The composition is mainly graphite.

The mechanical tests recommended are for the purpose of determining the strength, hardness and abrasive power of the brush, and the electrical test is for the purpose of ascertaining the current the brush is capable of carrying before glowing. The abrasive effect, while very important, is not definitely set forth in the report for the reason that it has not been possible as yet to find a short, concise method of determining the character of such a test. The electrical manufacturing companies and the manufacturers of brushes are at present at work on this matter, in order to find proper abrasive tests which will be of general and easy application.



VIBRATOR TEST OF BRUSHES.

In the vibrator test the brush is subjected to a series of mechanical shocks to determine how tough or brittle the brush may be. The vibrator consists of a ratchet wheel, the principle of which is indicated herewith. The diameter of the wheel should be 8 in. There should be eight teeth, the depth of each tooth being ⅛ in. Adjacent to the wheel a standard brush holder is mounted so as to allow the brush to bear on the wheel with a standard pressure of 7 lb. per square inch of the bearing surface or cross-section of the brush. The face of the ratchet wheel should be broad enough to take the widest brush. The ratchet or vibrator wheel may be belted from a line shaft or driven by a small motor. The speed of the ratchet wheel should be 250 r.p.m. With this speed the brush will receive 2000 blows per minute. The ratchet wheel revolves backward so as to slip under the brush, and drop the same down ⅛ in. as each tooth passes. The various classes of brushes should stand a certain number of revolutions of this vibrator wheel before breaking. The values given below for the different classes of brushes are suggested. It has been found that a brush which breaks badly in service will hardly run on this wheel more than 5000 revolutions, and one which is fairly satisfactory in service will run 20,000 to 50,000 revolutions. A brush which is of excellent mechanical quality will run 100,000 revolutions and show no breakage or chipping. It is suggested that coke brushes should stand 20,000 revolutions on the vibrator wheel; part coke and part graphite brushes, 30,000 revolutions, and graphite brushes, 50,000 revolutions.

While the vibrator test indicates tensile and crushing strength, and, in a degree, hardness, it is desirable to express in some simple form a hardness test which is not subject to serious error and can be within reach of all. This test consists of comparing the hardness of carbon brushes with various standard "H" drawing pencils. It is recommended that the Johann Faber pencil be adopted as a standard of hardness. This test consists of scratching the brush with pencils of various hardness to determine which hardness of pencil corresponds to the hardness of the carbon brush.

In the electrical test the current is passed through the brush to a slip ring to determine the maximum amperes per square inch which the brush can carry without glowing. The current from the ring may be conducted by placing copper brushes on the hub of the slip ring. The slip ring should be a wheel of hard copper 8 in. in diameter, ½ in. thick, and a width of face sufficient to test the widest brush. The wheel should be mounted and so arranged as to use a standard brush holder, the brush pressing against the slip ring as in the motor. The speed of the slip ring should be approximately 500 r.p.m. The slip ring may be driven from line shafting or from a small motor. The pressure per brush should be 7 lb. per square inch of bearing surface or cross-section. The periphery of the slip ring should have a true and smooth surface. The slip-ring wheel should run true so that the brush, when once fitted, will maintain a true and perfect-fitting surface. Twelve or 15 samples of each quality of brush should be tested. The current should pass from the brush to the slip ring; that is, the brush should be positive to the ring. Direct current should be used. The maximum of 25 volts will be suitable for testing ordinary railway brushes. The following requirements are suggested. It is hoped that the exact values will be definitely determined later. Coke brushes, 100 amp per square inch without glowing; part coke and part graphite brushes, 150 amp per square inch without glowing; graphite brushes, 200 amp per square inch without glowing.

It has been found advantageous on a number of roads to use one brush per holder, even though it is necessary to cut out the bridge in the brush box. The ridge in the middle of the commutator is avoided and, in most cases, longer life of the brush is obtained. Should there be irregularities of the commutator which would cause the brush to be thrown from the commutator, the entire circuit would be broken if one brush is used and less flashing would be obtained by the use of two brushes; this is particularly true of high commutator speeds. This matter is suggested and each road is requested to investigate and make its own conclusions. The committee did not make a general recommendation on this point because of various conditions met with in actual practice.

It has been the effort of the committee to put forward these general discussions and specifications, not with the idea that the definite values given or that the tests specified are absolutely the correct and only tests to make, but rather with the idea that out of its recommendation will develop certain valuable information and specifications which will be of very material assistance to the users as well as the manufacturers of carbon brushes and railway motors.

In the discussion on this part of the committee's report, Mr. J. S. Doyle said that during the last year the cars of the Interborough Rapid Transit Company had run about three billion miles with carbon brushes costing about six times as much as the ordinary carbon. This type of carbon has reduced troubles on the Manhattan Elevated about 85 per cent, and about 96 per cent on the subway. The cost of the carbon is about 17 3/10 cents per 1000 car-miles, as compared with a former cost of 44 cents per 1000 car-miles.

Mr. E. Gindre, of the Le Carbone Company, of Paris, France, said that he considered that a good brush should show a fracture of uniform appearance both crosswise and lengthwise and must be free from certifications and shrinkage cracks. He did not think that the vibrator test corresponded closely enough with the conditions of practice. He considered the slip-ring test a valuable one, and also found the resistance test of value, but he would suggest running two brushes of the same grade on a hard-drawn copper ring, 10 in. in diameter, a given current entering through one brush and going out through the other and in measuring the total contact drop of the two brushes. An important feature of every carbon grade is its friction coefficient and the friction losses should be measured. The rational abrasion test would consist in running different brushes on a soft material, the wear of which measured by the decrease in weight would be proportional to the abrasive coefficient. In regard to single- and double-width brushes, the advantage of single-width brushes is a better distribution of the current, as they fit on commutators better on account of their smaller sections.

Mr. E. T. Munger, member of the committee, said there had

been some objections made to the vibratory test, and the committee had agreed to make a change in the drop of ⅛ in. to 1/16 in. Also that the diameter of the wheel be increased to 9¼ in.

Mr. H. H. Adams, New York City Railway, thought the contact resistance test a difficult one to make, because the brush must fit properly. It is necessary that the brush fit properly also when testing for the current that will make the brush glow. Mr. Gindre proposed to take the slip ring, used for the glowing test, and with it measure the contact resistance. By mounting thereon a small motor for driving the wheel the coefficient of friction can be determined. With the vibrator wheel if one brush is destroyed at 10,000 revolutions and another at 50,000 revolutions, the inference should not be drawn that one will last five times as long as the other. The vibrator test as proposed is not a correct measure of the service, but a specification for a carbon brush is needed, so the committee has endeavored to prepare such a specification. Time may change it very materially.

Mr. Brady, National Carbon Company, thought that most of the tests advocated are laboratory tests which it is hard enough for the most experienced man to make accurately. Carbon, being of a cellular structure, has only a few points of contact, unless extreme care is taken in working the brush down to a true surface. This is one point which gives trouble, particularly on the slip-ring test, which is more a matter of contact resistance than anything else. A brush with a high contact resistance will glow more quickly than a brush with a low contact resistance. A brush with a high contact resistance is a good brush to have in some cases, while one with a low contact resistance in good in other cases. The same criticism he applied to the abrasion test and the other tests. It is all a question of the fit of the brush. In his own laboratory slip-ring test he found it necessary to run anywhere from 24 to 36 hours steadily on a smooth wheel to get the brush down to a true surface.

Mr. Roberts said that, while the amount of brush friction was largely determined by those who inspect and adjust the motors in the shops and car houses, the slip-ring, vibrator and abrasive tests which were the difficult ones to make, concerned the manufacturer chiefly and should properly be made in his laboratory.

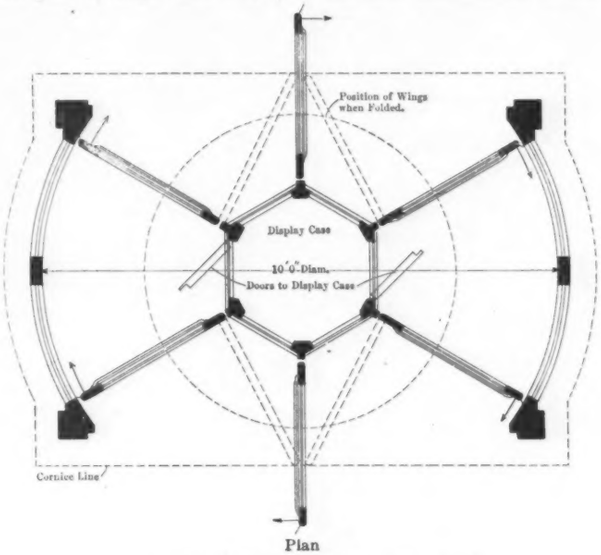
Mr. Winsor referred to the vibration tests offered by the committee, which he thought were a step in the right direction. The committee did not recommend a standard of how many vibrations a certain brush should make, but said that under certain conditions if it was found able to make 20,000 vibrations or revolutions it will stand up under certain conditions. It is the same way with steel and copper wire; if tested to the destruction point, certain information becomes available.

Novel Motor-Operated Door in Boston.

The Gilchrist Company, of Boston, has recently installed at its Washington and Winter Streets entrance a novel form of revolving door operated by electricity. The door is 10 ft. in diameter and contains a hexagonal display case in the center and six compartments, as shown in the accompanying drawing. Each of the six revolving wings is so arranged that when the wings are rotated, if any one wing comes in contact with a person or catches a person between the edge of the wing and the circular wall, the wing will flex back out of the way or slide past the person obstructing it. Each wing is also arranged so that it will spring in the reverse direction under pressure, so that in case of a panic people can pass out at each side of the center.

The door is operated by a ¼-hp motor on the 110-volt street service. The motor speed is 1500 r.p.m., which is reduced by transmission, so that the door makes about 6 r.p.m. The motor is located in a 20-in. compartment located 8 ft. above the floor over the top of the door and is controlled by a push button switch at the side of the door. The transmission is so arranged that if for any reason the wings do not flex back, a certain amount of slipping is allowed to prevent accident. Each compartment is large enough to accommodate two persons. The capacity of the door is 4320 persons per hour in each direction.

The advantages of a motor-operated door of this type are claimed to be the avoidance of congestion, safety and increased convenience. Women shoppers can pass in or out of a store without touching, pushing or pulling it at any time. A woman can pass through with a baby in one arm and bundles in the



Plan

MOTOR-OPERATED REVOLVING DOOR.

other with no more difficulty than in walking along a street, and there is no chance for confusion through oscillation or reversal of the direction of rotation. Blount air checks are used to swing the flexible wings into position in case they become displaced. The cost of the installation was about $2,400, and there are but six others in existence as yet. The makers are the Van Kannel Revolving Door Company, of New York.

Electrical Distribution Systems for Industrial Plants.

BY WARREN H. MILLER,
Electrical Engineer, Standard Oil Refineries.

There is always a great temptation for the electrical engineer to go to 2300 or 1100 volts whenever he is confronted with a few thousand feet of transmission and a few hundred horsepower to send over it. But, before jumping into the order book with this scheme, it is well to try on it a few practical considerations. This current is deadly; how deadly you will not realize until you help put into the ambulance a few innocent Hungarians that got in its way with more valor than discretion. Even a small shock from it feels like being instantaneously shut up in an enormous vise, whereas 440 volts is merely an enlivener. It is part of one's daily work to get "touched up," now and then, but not so vigorously that one has to go home on a shutter.

Keep away from 2300 volts about an industrial plant unless your distance is something over 4000 ft., say, and the horsepower is over 500. Below that you can do better in the end with 440 volts, no expensive transformers, and no widows' claims. About the only thing to do with the 2300-volt cable is to bury it. If run on poles, or on the buildings, it is a constant menace. If put underground in a conduit, every time a water main bursts or a steam line is put down, or a track laid—and these things are always being done about a live and growing industrial establishment—the working gang has this conduit loaded with murderous current to reckon with.

Using 440 volts, the preferred layout for the electrical distribution system of industrial plants would be plain triple-braid weatherproof, run on poles or brackets where everything is in plain sight and easily got at. The three-wire lead cable is

often used as an alternate for this. It is all right—until it grounds. Then is the time to go borrowing instruments and using up the works engineer's time, instead of letting the linemen use their eyes and the magneto. Do not count on the cable protecting you indefinitely from water or acid fumes. The lead covering always contains minute pinholes. There is no getting away from it, as anyone who has actually drawn lead will admit. Unless iron armored, the results are apt to be like the following, run under a 70-ft. race, 4 ft. deep: First month's service, faint ringing of magneto; second month, 105-volt ground; third month, 550-volt ground, ¼ amp current; fourth month, the cable was raised and run across the race on poles, just as the weatherproof on each side of it in half a mile of transmission. As there was a railroad yard on each side of the race, it made an awkward proposition, but it had to be done as the lead was full of pinholes all along the cable.

But there is never any difficulty from grounds, year in and year out, with plain weatherproof, well put up and properly tarred. To tap off such lines, cast-iron weatherproof fuse boxes are sold by all the electric companies. Also cast-iron weatherproof switch and panel boxes in various sizes. In ordering these, be sure to specify brass bolts and wing nuts for the cover plates. These are always furnished otherwise in iron, with the result that, after a few months' weathering, the iron threads are so rusted as to be unrecognizable as such.

In figuring the power and light transmission lines, the writer has got very accurate voltage drops using the standard General Electric formulas on 80 per cent power factor for power and light with transformers, and 90 per cent for straight light distribution. Mershon's method gives results slightly under the General Electric, as the figuring is closer, and the reactance calculated instead of being shoveled into a constant. It is no trouble at all to work both methods together, allowing one to check the other.

When there are a number of buildings with parapet walls along the transmission, a simple and cheap pole scheme is to use 4-in. x 4-in. hard pine poles, 10 ft. long, bolted to the walls with expansion bolts. A locust pin is let into the top of the pole and bracket pins nailed in pairs at 12 in. vertical spacing on opposite sides of the 4 in. x 4 in. The wires are tied in on the outsides of the deep-groove insulators, giving a spacing apart of 12 in., which follows Underwriters' requirements. By placing the power feeders on the top pin and first pair of brackets, a triangular arrangement is obtained which gives minimum mutual induction. Spaced 50 ft. apart, 2-0 solid weatherproof is about the heaviest that can be run on such poles.

When there are 10 to 20 wires to be run, it will hardly pay to use anything but 40-ft. poles, put down along the industrial plant streets at 125-ft. spans. The stock woods are cedar and chestnut, the former being the better and stouter pole. They are sold by measurement across the top. A pole of 6-in. top will run about 42 ft. long and 14 in. at the butt. It will carry four 500,000 circ. mil cables or their equivalent in smaller wires at 100-ft. span and 3-ft. sag. Seven feet of it should go under ground and be well tarred before dropping into place. Use only Eastern climbers for all pole work where chestnut or other hard poles are likely to be bought. The Western climber is only good for cedar, and is not used at all by the men themselves if they can get the other. To plant the poles, the gang will need one "deadman," or jenny, and three or four pole sticks, one of them being 18 ft. in length. The gang will muster five men and will need two pole hooks, an iron spud or rammer, three shovels and a post spade with 8-ft. handle, besides the pikes mentioned above. The hole is dug 7 ft. deep and 2 ft. in diameter. Start the butt well in, raising the pole from the outer end and holding it with the jenny while the pike men get a fresh hold. One after another the pole sticks will come into play as the pole raises. When nearly upright, meet it with a pike on the opposite side. A barrow load of brickbats dropped in around the butt is a sure preventive of troubles from leaning poles and should always be put in when the soil is soft. In marshy ground the hole is made 3 ft. in diameter and filled around the pole with concrete.

Before filling, the pole is plummed and the earth is then shoveled back slowly, one shovelman to three tampers. If the holes are dug in advance the gang can put in 15 to 20 poles per day. The smallest pole that will bear a wireman's weight is the 4 in., which runs about 32 ft. long and 10 in. at the butt. It will not stand more than two cross-arms carrying two 2-0 wires or their equivalent. The standard two-pin cross-arm is 3¼ in. x 4¼ in. section and 36 in. long, the four-pin 28 in. longer and the six-pin arm about 7 ft. long. Both are bored for 1½-in. x 9-in. wooden or iron pins, the latter being preferable because they will not bend. If the wire is too strong the oak or locust pin breaks off short—which is a good thing to know at the start. Nothing looks so sorrowful as bent and drooping iron pins and they do it most aggravatingly as soon as any strain is put on the wire. The writer also prefers to let all iron poles remain in the draughting office—because they are so perfectly awful about grounding in wet weather, and are then dangerous for the linemen to work on.

In laying out pole lines, avoid all curves and frequent bends. Remember that every pole on the bend will require a guy wire, perhaps two. Run perfectly straight lines from angle to angle and concentrate all guy wires on the angle pole, which should be the heaviest pole in the shipment. If running across open fields, bare wire is all that need be used, and lightning arresters should be put on every sixth pole. In tying-in weatherproof, practical electricians' sizes are for 4-0 to No. 1, use No. 6; for No. 2 to No. 6, use No. 8; for all smaller sizes use No. 12, except No. 12 and No. 14, which take No. 14.

As to linemen's tools, one good parallel grip, taking from No. 0 weatherproof down to No. 6, is all that will be required per gang of linemen. Besides this will be needed a block-and-falls for 1-in. rope, and some light ½-in. hemp rope for the sheaves of the wire-grip. The block-and-falls will be used to stretch wire. Every single length of it, from No. 6 to No. 4-0, must have the "stretch" taken out of it if smooth, straight line work is to be put up. It will not do to try and put up the wire direct from the coils. No pole will stand the strain requisite to "set" the wire and take out the kinks. The length to be put up is anchored to the bottom of the first pole and led down the line. Not over 400 ft. of 2-0 can be stretched at a time, but a gang of three men at the falls can put that much into shape for hoisting. As soon as stretched, the ½-in. lines come into play and the line is lifted carefully up onto the cross-arms. Then the wire grip is put on and the wire pulled taut to the desired sag, which may be 2 ft. to 3 ft. in the hundred. At the last pole the line is run straight down to ground, tied, and another 300 ft. stretched. All smaller wires, from No. 2 to No. 6, can be done in 800-ft. lengths, using a snatch-block at angles.

The only practicable insulator for heavy sizes of wire is the form with the saddle groove over which the wire can be stretched. For 2-0 and smaller, deep-groove insulators are suitable, and the wire is not too large to enter the groove. Whenever practicable, the wire should be tied on the right-hand side of the insulator, looking in the direction it is being stretched. The idea of this is that the instant the strain is off, the wire tries to come back, and to do so must screw up the insulator. As this is already on tight, the line is held fast. If put up on the opposite side it will unscrew the insulator about one-eighth turn and make a slack, unsatisfactory job. On all large sizes, even as little as ½ in. slack makes an astonishing difference in the appearance of the work.

For soldering and splicing wire it is well to keep on hand a few lengths of brass pipe of ⅜-in., ¼-in. and ⅛-in. gas pipe sizes. To splice 2-0 use a 6-in. piece of the ⅜-in. size. It must be slipped 3 in. on the bared end of the wire to be spliced and taped securely to the insulation. It is then wetted down with soldering acid and the torch applied to both it and the soldering stick until it is full of molten lead. The 3-in. bared end of the other wire is now slipped into the splice and the joint allowed to cool. For heavy taps use brass tees to match the pipe, and solder in both ends of the main and the end of the tap. Do not use soldering acid on small wire. The various resin soldering

sticks on the market are better and cleaner, and will not eat away the wire after the job is taped up, as sometimes happens with acid.

On all overhead work of this kind it is poor economy to work the linemen when the wind is blowing hard. The torches then give a good deal of trouble to keep lit. Better put the men on some other work. If the lines *must* be pushed ahead, use two torches per man. They heat up the work better and quicker, and one instantly relights the other in case of blow-outs. Solderless couplings are replacing much of the torch work on overhead lines, as they save an astonishing amount of time wasted in fussing with the torches. On aluminum wire, where soldering is very difficult, they are almost a necessity.

In figuring incandescent light wiring, the standard direct-current formula applies equally well to alternating-current work. The lights are run on three single-phase circuits more or less balanced across the adjacent terminals of the three-phase machine. If the voltage for lights and power is 220, with 230 at the alternators, the feeders are run out direct from the light panels with the drop divided between them and the mains according to the distance of the latter. Three per cent in the feeders and two in the mains work out well in industrial-plant distribution. If the arrangement of buildings is symmetrical so that the lamp center is a geographical point, then the "star" system, with the feeders entering the central switch panel-box, is the thing. If, however, the lamp center lies in a line, such as a circle or rough rectangle, as in the case of scattered buildings, the "closet" system, with the feeders tapped into the mains on opposite sides of the rectangle at points equidistant from the power house, gives the best results. In this case a circuit is picked out, from which groups of lamps can be tapped off at intervals, and thus cover the area to be lighted. The two mains follow this circuit, each main being a closed ring. Then two points are located on opposite sides of the circuit that are equally distant from the power house, and the feeders tapped in at these pointts. The result of this arrangement is that, no matter where a group of lights is taken off, the total distance through mains and feeders will always be constant, and hence the voltage is the same at every point in the mains. Incandescent lamps will not stand but a very few volts' overglowing without wearing out very quickly, and if underglowed even 3 volts or 4 volts will lose a big per cent of their candle-power. In the old "tree" system of wiring this matter was politely ignored with consequent continuous lamp troubles. The only relief was to keep in stock a variety of different voltage lamps, which proceeding introduced, in its turn, confusion and much hard feeling. A pernicious relict of this evil is to saddle the "tree" system on the "star" wiring layout. The designer gets his cabinet boxes located and then proceeds to lay out a number of trees under the impression that he is making a star system. The nearest lamps to the distributing cabinet are all overglowed and those out on the dangling ends are somewhere a few shades above dull red. A set of submains, of course, should be run to carefully selected lamp centers, from which branch circuits are led off, none of which has a drop exceeding 1 volt from tap to end. On the whole, the closet system covers the area with the simplest arrangement of poles, most of which may be on the buildings themselves.

For power distribution, one's aim should be to "git thar fustest with the mostest—current," as old General Forrest would have said. Run feeders direct to the various motor centers and branch to each motor. If only three or four motors are on a given circuit, it is well to finesse a little on the cost of wire vs. the cost of cast-iron fuse boxes and fuses. For instance: Suppose the line has four motors on it and the feeder is three No. 2 wires. One way to do it would be to run four small circuits of No. 6 to each motor. This means 12 fuses and four fuse boxes at the distributing point. A better plan would be to run two circuits of No. 3 and No. 4 wires running direct through them from the No. 2 to the motor compensators. No fuses will be needed at the junction with the No. 2 feeder because it has only 100-amp fuses on it where it leaves the power main. These 100-amp fuses take care of all four motors at full load and also protect both the No. 3 and No. 4, whereas they would not protect the No. 6, which is only safe for 57 amp. The additional cost of the No. 3 and No. 4 over the No. 6 is less than the extra cost of fuses and fuse boxes. The same idea holds good in branching to small motors requiring, say, No. 8 taps. Theoretically you would put fuses in each branch where it leaves the No. 4 main. Practically you want those fuses right at the motor to avoid putting in still another set, so you make both branches No. 4 also, so that the fuses which protect the main will protect the branch also. The costs of the small branch fuse boxes and fuses figure out $29.05, whereas the difference between 1000 ft. of No. 4 and No. 6 weatherproof runs about $13.90.

Once inside the building the very best thing to do is to run everything in a first-class iron-pipe conduit system. The conduit passes through the wall and may terminate in either a standard iron entrance cap or a type T condulet. All wire in the conduit must be rubber covered, and pulls better if double-braided than if single. The splice between it and the weatherproof is made in the drip loop from the wall-insulator bracket to the entrance cap. The first thing inside the building is a cast-iron box containing the main service switch and fuses. Adjoining it may be a cast-iron "ironclad" circuit cabinet and meter loops. If there is still some way to go before arriving at a motor center, better come right off the fuse with a plain cast-iron junction and pull box about 8 in. x 8 in. x 6 in. dimensions. While the conduit people give maximum sizes of two-wire main and feeder wires that can be pulled in a given conduit, in three-phase work there are no such data. The writer has found the following as maximum sizes that can comfortably be pulled through conduit: Three No. 8, ¾-in. conduit; three No. 4, 1¼-in. conduit; three No. 1, 1½-in conduit; three No. 0, 2-in. conduit. Everything from No. 4 up should be stranded. The wires are pulled in by a conduit "snake" or fish-wire. This reptile is nothing more formidable that a steel flat, ¼ in. x 1/16 in., and comes in 150-ft. coils. It is flexible and springy, and will not kink, so that it can be fed into any amount of conduit. The end is hooked over and the wire looped through it, or else a wire cable grip, that will seize three wires at once, is used. Arrived at the motor, the conduit first enters an "ironclad" switch and fuse box, out of which are led the six taps to the compensator or auto-starter. This is supposed to have six fuses, but, to avoid special cast-iron boxes, it is well to tap off above the fuses for the starting position and below them for the running position, using only three fuses.

The usual wrought iron outlet boxes are of little use in motor work, owing to the small ½-in. and ¾-in. knockouts and the limited space in the box for splicing. Cast-iron junction and pull-boxes of not less than 8-in. x 8-in. x 4-in. sizes make very satisfactory work. Junctions from conduit to motor are made through condulets or "union fittings," either being satisfactory. For lighting circuits, cast-iron switch and fuse cabinets of almost any number of branches can be had, both two-wire and three-wire. Outlet boxes for ½-in. and ¾-in. conduit take care of branch circuits, in which twin-wire, double-braid, rubber-covered wires are used for both submains and taps. The number and variety of covers obtainable for outlet boxes are virtually endless. For shop "drops" the cover with 13/16-in. hole gives a very complete job, the rosette being set inside the box and projecting through the 13/16-in. hole. The drop itself may be of armored No. 18 flexible cord terminating in a rosette bushing at one end and a standard keyed socket at the other. Such a drop may be trodden on, hung over the rough edge of a boiler plate, squashed under a heavy casting, or otherwise maltreated without being seriously affected.

For general illumination the writer prefers tungsten clusters to any other powerful illuminant. A tungsten or tantalum cluster of four 40-cp lamps will give a splendid illumination with factory clusters 12 ft. from the floor and spaced 30 ft. apart in the bays—one to every two 15-ft. bays. The entire illumination of a group of shops, consisting of machine shop 110 ft. x 60 ft., boiler shop 210 ft. x 120 ft., pipe shop 80 ft. x 60 ft., and carpenter shop 60 ft. x 50 ft., was less than 12 kw, using "Gem"

metallized filament drops for the lamps and four-light Harter clusters with 40-cp tantalum lamps for general illumination. The light was far more satisfactory, both as to quality and amount, than any of the older shops lit with enclosed arcs.

Where a conduit system is not available, such as in a chemical works, the next best system of distribution is good, hard yellow pine molding, well tarred inside and out before the wires are run. Aside from expensive marine fittings, it is the only way to put on lamps in which no metal is exposed to either moisture or acid fumes. In the latter case, even marine fittings will not do, as the metal parts in time will become dangerously corroded. But with molding, a porcelain molding receptacle can be put on wherever needed. The cap is cut where the receptacle is to go, exactly its length. The wires are raised out of the tar and bared where they pass over the receptacle connections. After tightening up the screws, the porcelain cap is put on and screwed down. The lamp is now screwed into the receptacle and the affair is absolutely moisture-proof and fire-proof except for the annular ring between the lamp and the porcelain. You cannot seal this with wax or crude paraffine, as the heat of the lamp will melt it out. But, by cutting a piece of No. 14 weatherproof and bending it around the lamp to make a ring, this opening is easily and effectually sealed. A turn of tar, put on with a small brush, will make it waterproof also.

Much of ordinary factory wiring is done on the "knob-and-cleat" system. It is the preferable installation in "standard mill" construction, where the wires run from cord to cord of trusses. For all large work knobs that grip the wire on screwing home will give very satisfactory jobs. To get smooth, straight runs without taking up an undue amount of time, see that the electrician tightens up his wire from cleat to cleat, not by attempting to stretch it by hand or by a wire grip, but by the simple expedient of gripping the wire with his pliers back of the cleat and tautening the wire with a half-turn of the pliers, using the cleat as a fulcrum. This he does with his left hand, at the same time screwing home the cleat with his right. In this way there will be no disappointing slackness when the strain is off the wire.

A few other construction "kinks" that may be mentioned are as follows: Use 2-penny copper nails on all molding caps. Steel nails tend to rust and let the caps warp and hang loose. Wood screw sizes are another matter more or less in obscurity. For 1⅞-in. knobs, 2¾-in., No. 14; cleats, 1½-in., No. 12; molding receptacles, 1¼-in., No. 10; fuse blocks, 1½-in., No. 12; entrance switches, 1½-in., No. 10. These latter are combination porcelain blocks, mounting fuse plug receptacles and a two-pole knife switch.

All these screws must be round-head blued steel. The average electrician is so horny-handed that he cannot feel 240 volts at all and is sure to drive in a screw just as tight as he can get it without actually cracking the porcelain. If this is a flathead screw, in a few months its slot will have rusted up, and no power on earth can start it out again.

Use only the very best grades of gasoline in the blow torches. Anything below 76 deg. is impossible, as the torches will be always going out and the men will lose half their time in fussing with them.

For pole work, make up a couple of light spruce three-cornered stagings. These may be of light ¾-in. x 10-in., four boards wide, with 1½-in. x 3-in. rock elm underframing, nailed on V-shaped. Three ropes are attached to the framing, one on each end of the V-frame. The two at the large end tie to the pole cross-arm, and that at the point to the nearest available wire already on the pole. Repairs, especially soldering jobs, will go just about twice as quickly if the electrician does not have to improvise something to hold his tools and constantly hang on to the arms with feet or hands while at work.

When you get pole climbers, get the best. Use only Eastern climbers for chestnut and oak poles. The Western climbers will do for soft cedar or Norway pine at a pinch, but even there the Eastern type is stronger and safer. A slip or a break on a pole is often fatal, and you are directly responsible for your electrician's injury. As to size, the climbers run from 14 in. to 17 in., 16 in. being average, though you occasionally strike a gander-shanks who asks for a pair of 18-in. spurs.

In putting on guy wires, which run from ⅜ in. to ⅝ in. ordinary sizes, tie the wire just as close below the top arm as it can be got. It is against all laws of bending moments, but at the same time it is astounding how neatly a pole will break off short at the guy if put on too low. The only fitting needed in guy work is a good clamp—something solid and heavy. Turnbuckles are not needed, as the pole is always braced back with the tackle before tying the guy wire. The guy stake should go into the ground vertically to give maximum resistance. Driving with the point inclined toward the pole looks strong, but the first storm will rip up the earth above it, and away goes the pole, while the vertically-driven pole has all the lateral pressure of the earth to keep it there.

Of course, every good line foreman is well posted on all matters pertaining to practical inside and outside wiring, but the time will surely come when the electrical engineer himself will have to get down and teach these things to a raw gang. He should know them, anyway, in order to be able to judge good work or correct faulty construction.

Typical Electric Motor Failures.

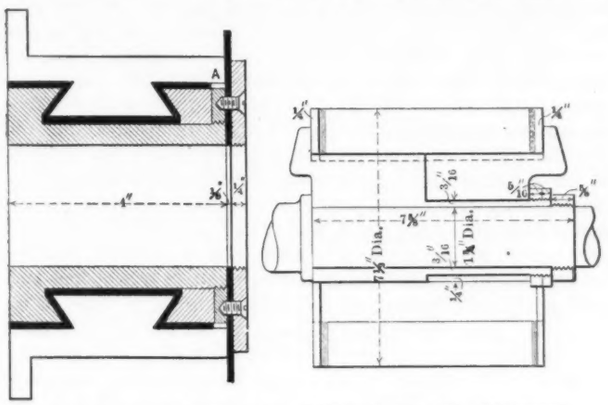
The study of electric motor failures in modern practice is certain to convince one that the majority of break-downs are avoidable, provided the investigation of accidents is carried over a considerable period. The reason is that the fundamental causes of trouble are relatively few in number, while the practical variations upon these causes are almost infinite in variety. From the reports of an accident insurance company a number of recent motor failures have come to hand which illustrate the unceasing importance of keeping even low-potential motors clean, purchasing only machines of good mechanical design, avoiding excessive and sustained overloads, and looking out for first-class construction in original selections.

Foreign bodies in moving machinery are always fruitful sources of trouble, but in the operation of electric motors freedom from such disturbing factors is imperative if continuous service is to be secured. The case occurred of a three-phase alternating motor wound for 500 volts which had six stator coils completely stripped and 15 of the rotor coils badly damaged. The case was full of small pieces of copper, on examination. The rotor was found to be damaged at but one place, and from the force expended at this point it was clear that some foreign body had become caught in the rotor winding and been carried around with the coils. As the binding wires were intact it was evident that the coils had not been lifted by centrifugal force.

Another similar accident occurred to a 1½-hp motor driving the scrapers of an economizer, the rating being 230 volts, 1300 r.p.m. The insulation was rubbed off the windings at the driving end by some hard substance which had become wedged between them and the back flange of the frame. Twelve coils were burned, and when these were stripped off others were found to be burned, so that the armature had to be rewound. It was thought by the inspector who examined the motor that a piece of the flange of one of the vulcanite bushings through which the leads from the brushes were carried to the main terminals fixed on the outside of the frame might have caused the accident. In the case of another motor the solder around the armature end connections was partly melted off, and on taking off the armature four coils were found to be burned out. A piece of cinder was wedged into the space between two of the conductors and the end of the core. As the motor was of the enclosed type, it was difficult to account for the presence of the cinder, unless, as the chief engineer of the insurance company suggested, it might have got into the armature through rolling on the ground in a careless way at some time when the armature was out of the frame. Another instance of damage by foreign matter getting into a motor was in an installation where the upper coil of the stator winding, carry-

ing current at 250 volts, was burned out, and the coil grounded. The cause was the saturation of the coil by soft soap. The motor was protected by a water-tight iron box, which had become a receptacle for tools and odds and ends, among the débris being a handful of soft soap which ran down upon the windings.

Fires inside motors caused by the accumulation of carbon dust, fluff and dirt are not uncommon. In one case where smoke was found issuing from a motor case it was discovered that it came from the ignition of oil, dust and dirt which had



FIGS. 1 AND 2.—DEFECTIVE COMMUTATOR AND ARMATURE.

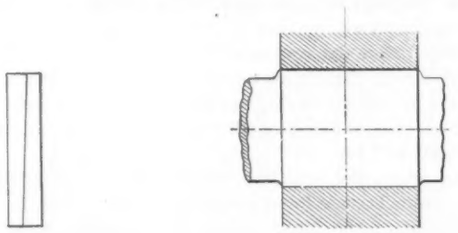
accumulated upon the bottom of a magnet coil, sparks from the brushes having set the fire. The sparking was caused by one of the carbons becoming jammed in its holder. The insulation of the coil was also slightly charred. In another case of dirt and general neglect a motor of 80-hp rating was protected by a fuse of 2½ times its normal current capacity. The fuse gave out, and on examination two of the armature coils were found to be burned. The remaining coils were saturated with oil and very dirty. The insulation of the commutator segments was burned close to the spokes through oil and dust settling between the spokes and short-circuiting them. This insulation, instead of being carried up a short distance between the spokes, ceased at the ends of the bars, leaving a very narrow wedge-shaped opening between the edges of the spokes to retain oil and dust. The machine was so damaged that the armature had to be completely rewound, and the commutator rebuilt and reinsulated.

The failure of a motor-generator from excessive speed in starting up was suggestive. The normal speed of the set was 1080 r.p.m. In starting up the machine one evening sufficient speed was gained to break one of the steel binder wires at the higher tension end and spread the conductors until they became wedged between the pole pieces. On examination it was found that one end of the shunt winding had slipped out of its terminal. It was thought that the wire had been pulled out in cleaning the machine. In some cases the accumulation of carbon dust and the use of made-up mica have apparently been the cause of motor failures. One case occurring was that of a 220-volt crane motor, which had the solder melt between the commutator lugs and the armature coils. On test the insulation of the armature coils proved satisfactory, but the commutator segments were short-circuited by carbon dust, which had worked in between the flakes of mica of which the micanite plates between the bars were made. These short-circuits were not only at the surface, but extended into the interior of the commutator. In another instance a commutator had 153 segments, all but one of which were insulated with mica plates. The exception had micanite insulation. The two coils in connection with this segment were burned out and had to be replaced. The cause was a short circuit across the micanite insulation produced by carbon dust and oil penetration. The other segments were as dirty, but the mica segments had maintained the insulation.

A case of commutator trouble occurred to a crane motor having a full load rating of 150 amp at 110 volts at 750 r.p.m., the crane having a capacity of 15 tons. The commutator was built on a cast-iron sleeve, to which the segments, 76 in number, were attached by an iron clamping ring, 4⅜ in. in diameter, and a nut of the same diameter as shown in Fig. 1. The ring was provided with a keyway to prevent it from turning when the nut was tightened, but no keyway had been fitted, nor was there any corresponding keyway in the sleeve. The micanite ring for insulating the copper segments from the iron clamping ring was carried over the edge of the ring, but not over the nut. Outside the nut was a micanite washer, 6½ in. in diameter and ⅛ in. thick, held in place by six ¼-in. screws. Any slackening of the clamping nut or shrinking of the micanite washer allowed carbon dust to get into the space under the ends of the commutator bars, whence it could not be removed. Short circuits were established between the commutator bars and the fuses blew. When the motor was examined it was found that there was a short circuit between the bars and the iron clamping nut as well as between the bars themselves. Eighteen bars were burned, most of them being at the point *A*, showing that the clamping nut had been slackened, or that the micanite ring had shrunk and allowed carbon dust to penetrate between it and the ends of the copper bars. The clamping nut was also severely burned. In rebuilding the commutator care was taken to fix the clamping ring, lock the nut, and continue the micanite insulating ring over it as well as over the clamping ring.

A failure of a rolling mill motor rated at 110 amp, 240 volts, and subjected to several reversals per minute illustrated the effects of hard service. Two of the armature conductors were burned out, and the armature was sent for repairs. When tested after the repairs a large number of short circuits were found between the commutator bars. The commutator was taken off, and it was found that the bars were from 1-16 to ⅛ in. deeper than the mica plates between them, and that in many places arcs were formed across these gaps. These short circuits, according to the best opinion, had undoubtedly caused the trouble with the armature coils. One of the driving lugs on the sleeve which carried the armature was broken, and the armature spider was very loose upon the shaft. When the two taper pins which were driven in at each end, half into the spider and half into the shaft, were slackened, and the armature lifted, the shaft dropped out. Its diameter was 1-32 in. less than the armature bore. A new shaft had to be fitted, and the commutator rebuilt.

In another instance a series-wound crane motor had a spider secured upon the shaft by two taper keys instead of two taper pins, one at each end of the hub, and by a set screw through the hub at the driving end. After the motor had been in operation about two years a crack was noticed in the driving end of the hub, and the hub was seen to be loose upon the end of the shaft. On taking out the set screw the shaft dropped out of the armature. Measurement showed that the bore of

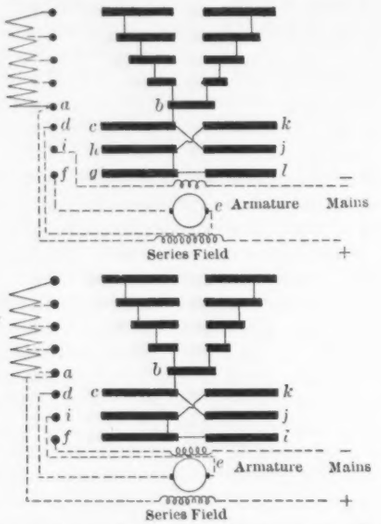


FIGS. 3 AND 4.—DETAILS OF SHAFT AT COUPLING.

the hub was nearly 1-32 in. larger than the diameter of the shaft, and examination of the surfaces that the two had been in contact and rubbing diametrically opposite to the two keys, and not elsewhere, and that the sides of the keys were worn by the first movement. It was uncertain how the hub was first cracked but it was thought likely that the tapered key was overdriven when the shaft was put into the armature. This was also probably the reason why the set screw was put in. A new shaft was made and fitted into the old spider, the cracked end of the hub being hooped to save rewinding the armature.

A series-wound six-pole enclosed motor driving a 10-ton crane had a break-down. The voltage of the circuit was 500, and the motor speed 400 r.p.m. The armature was withdrawn on account of the fuse blowing. The coils at the pinion end were found to have been rubbing against the back end plate, and two of them were fused. The armature had to be rewound. The damage was caused by motion of the armature along the shaft. The spider on which the armature core and commutator were built were held by a single key 14 in. long, ½ in. wide, and 5-16 in. thick, bedded on a flat space on the shaft. There was no collar or nut. The jerks caused by the motion of the crane and the vibration of the gearing had loosened the key and left the armature free to slide along the shaft.

A case of breakage between armature and commutator connections was investigated by the accident insurance company. The spider which carried the core plates was made in two pieces as shown in Fig. 2. The longer piece was fixed by a key and secured by a nut, the shorter by two weak nuts each 5-16 in.



FIGS. 5 AND 6.—DIAGRAM OF CONTROLLER CONNECTIONS.

thick. The only driving force upon the core plates was the friction resulting from the pressure of the two flanges of the spider upon them. Had the spider been properly constructed with a slight gap between the ends of the two pieces, this pressure could not have exceeded the maximum which one of the weak nuts could have exerted, but as the ends of the two pieces touched it may have been much less. It was not surprising therefore that the core plates moved and carried the conductors with them. The spider was also loose upon the shaft, for when the nut at the end was unscrewed the shaft dropped out.

Another instance of poor construction occurred in the fusing of the leads to the slip rings of a three-phase induction motor. It was found that the core plates had been threaded upon the shaft and a ring shrunk on at each end to hold them. There was no key or feather to prevent turning. The conductors were led over the ends of the core through a hole in the shaft, which was hollow, and out at the end to the slip rings. This hole had sharp edges and was not bushed with insulating material, hence the rotor became loose and rocked upon the shaft, rubbing the insulation of the leads where they entered the shaft and short-circuiting them.

A case of shaft breakage occurred with a dynamo driven through a coupling. The clear distance from the end of the coupling next the armature to the bearing for the armature shaft was 1¾ in. The diameter of the end of the shaft where the coupling was keyed was 2½ in., and the keyway was ⅝ in. wide and 5-16 in. deep. The shaft was of steel. It broke close to the coupling in a plane at right angles to the axis. The fracture was evidently of some time's growth, and apparently had begun at the circumference and gradually extended. The possible cause was that the bearing had become a little out of level during the machine's life and allowed the shaft to bend slightly while running, and that the edge of the coupling had thereby been pressed into the skin of the shaft and started a skin crack, which after the manner of slight cracks or scratches in steel under alternating stresses had gradually worked its way through the cross section of the shaft. Had the shaft been enlarged or grooved where it entered the coupling, as shown in Figs. 3 and 4, the skin of the shaft could not have been indented by the edge of the coupling.

The importance of providing proper connections and diagrams to be followed in installing motors was illustrated by a crane motor trouble. The motor operated a 15-ton crane and received current at 240 volts. The four field coils burned out, but the armature was uninjured and the fuse did not blow. The inspector who examined the motor was informed that it always started with a jerk and ran at the same speed on all the contacts of the controller. Four new coils were installed, but the machine would not run. On testing it was found that polarity of the successive poles was similar instead of dissimilar. The two top coils were turned around and the fault rectified. When this had been done the motor started and ran well in one direction, but on reversing, the armature refused to move, and the contacts sparked badly. After some trouble in tracing out and making a connection diagram, the inspector found them to be as in Fig. 5, so that when running forward the current, after all resistance had been cut out, passed through both field coils, controller and armature by the path *a b c d e f g h i*, but when the controller took the reverse, the current went through the path *a b c j i*, Fig. 6. The armature was thus cut out of circuit and the field coils left connected across the mains, which accounted for the trouble. The inspector altered the connection *i* and *f* as shown in Fig. 6, so that the path of the current on reversal became *a b c j i e d k l f*.

Forced Draft for Steam Boilers—I.

By W. H. Wakeman.

The first point that is presented when commencing to treat this important subject is, while it is well understood that the title of this article refers to the process of forcing air through the furnace of a steam boiler, in order to burn fuel on the grate, it is not always applied with exactly the same object in view, and, while this difference is not always recognized and understood, it exists nevertheless and partially accounts for the fact that the system gives satisfaction in some cases and is rejected in others. This difference is explained as follows:

Suppose that a certain plant has been operated for years by the use of egg coal, and 12 lb. of it are burned on each square foot of grate surface per hour. Competition in business has reduced the profits of manufacturing until it becomes necessary to economize as much as possible in every department. The chief engineer is asked to devise means for reducing the cost of fuel and report accordingly. He recommends the substitution of buckwheat coal, but states that it will be necessary to install apparatus for forcing air through the body of fine coal, as the natural draft available is not sufficient. After due consideration of the cost of making the change, and the possible benefits to be derived, it is decided to purchase and install the required machinery.

When the new system of burning fuel is put into operation it is properly called changing from natural to forced draft, but what constitutes the real difference? No more heat is required, therefore only 12 lb. of coal are burned per hour on each square foot of grate surface, as before. There is no good reason why the new system of making steam should be more destructive to the grates, or wear the boilers out faster, yet a large majority of engineers and steam users will hastily conclude that this will be the inevitable result. The mechanical draft is used to force the same quantity of air through small openings in the mass of fuel on the grates that was formerly forced through much larger openings by natural draft. Unprejudiced and intelligent consideration of the subject shows that the heat striking the boilers and going over the bridge

walls is no greater than before, therefore the effect cannot be disastrous.

On the other hand, a plant may be operated under conditions which require the use of 10 lb. of bituminous coal per hour on

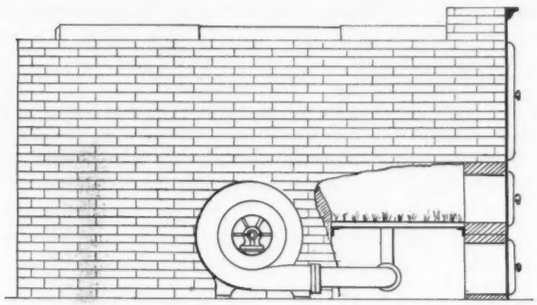


FIG. 1.—BOILER EQUIPPED WITH HOLLOW GRATES.

each square foot of grate surface, and the available draft may not be sufficient to admit of much increase in this rate of combustion. Business is increasing fast, causing the plant to be shut down occasionally for lack of steam enough to carry the load. The owners do not wish to install more boilers for another year at least, and a new chimney cannot be built there.

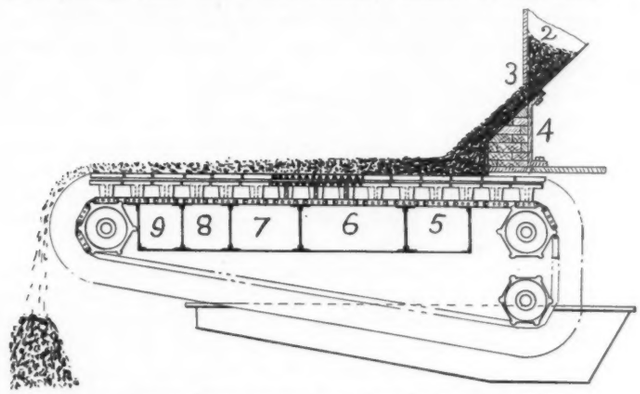


FIG. 2.—COMBUSTION ZONES ON MECHANICAL STOKER.

The chief engineer is asked to submit a plan for producing double the quantity of steam with the same boiler plant. He reports that there is but one plan to adopt, and that is to install forced draft apparatus.

His report is accepted and the recommendation adopted. The quantity of air going through the furnace is now twice as much as before, consequently 20 lb. of the same kind of coal are burned on each square foot of grate surface per hour, the

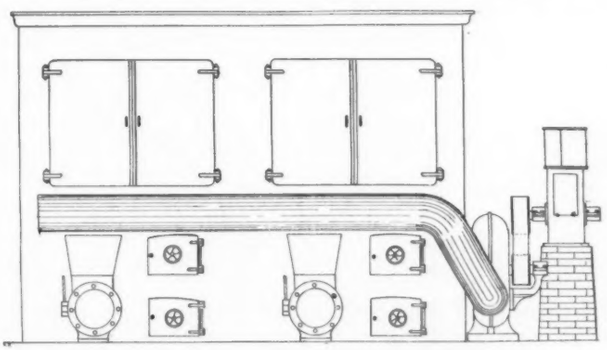


FIG. 3.—BOILERS FED FROM COMMON AIR-PIPE LINE.

resulting heat soon burns the lining off the furnace doors, the side walls are destroyed in a few weeks, and it is evident to all observers that the boilers are wearing much faster than when used under more favorable conditions.

This state of affairs agrees with the popular conception of what is meant by the use of forced draft, with all of its objectionable features. In order to show the loss due to higher rates of coal consumption, the following quotation is made from the specifications under which many boilers are sold and accepted:

When the rate of coal consumption is 18 lb. per hour per square foot of grate surface, not less than 12 lb. of water shall be evaporated from and at 212 deg. F. per pound of coal. When 24 lb. are burned the evaporation shall be not less than 11.5 lb., and for 30 lb. of coal it shall not be less than 11 lb. Of course, these rates are very high, but the difference in the evaporation required shows that, as the rate of consumption is increased beyond reasonable limits, the boiler efficiency is reduced.

In order to cover the subject thoroughly the following evidence concerning the effect of increasing the coal consumption, in cases where the whole is on a lower basis, is introduced. This is found in the report of two tests made where everything was practically the same, except that the rate of combustion was changed. Both tests were made on the same plant. While burning 10 lb. per square foot per hour, each pound of dry coal evaporated 9.44 lb. of water, but when the rate of combustion

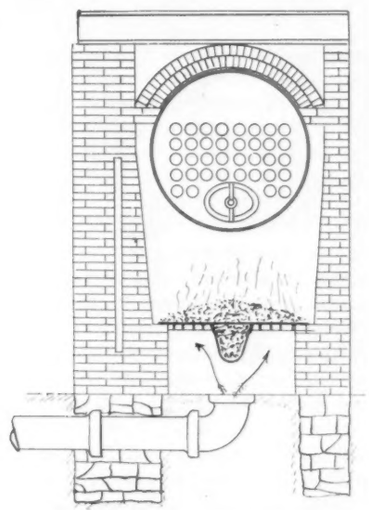


FIG. 4.—BOILER EQUIPPED WITH UNDERFEED STOKER.

was raised to 20 lb. the evaporation was reduced to 6.83 lb., showing a very great difference in the results secured.

It is possible to secure the report of tests which show different results from the above, but conditions were not the same, and, furthermore, a statement of what has been done elsewhere does not affect the result secured here, as the high rate is not the best, hence it should not be employed in any plant where conditions are not right for it.

There are several ways of producing forced draft, one of which is the use of a fan for forcing air into hollow grates which contain small openings on the upper side (see Fig. 1). If a furnace should be fitted with these grates exclusively it is plain that air could not be secured through them for even a moderate rate of combustion with free burning fuel when the fan was not in use. It is not expected that provision will be made for operating even 25 per cent of the plant fitted with these grates by natural draft, but when there is no steam on the boilers means must be provided for maintaining fire on at least one grate until there is enough steam to run the fan. This feature is provided for in some cases by leaving a space between each pair of the hollow grates through which air can circulate. In others the same result is secured by putting a common bar between each pair of the hollow kind, which leaves more air space without allowing fuel to drop down into the ash pit and thus become a total loss. In all cases the blast of air under pressure is delivered through the grates so as to siphon more air inward through these openings, hence the amount delivered is much greater than the capacity of the fan.

One great advantage of the system of hollow grates is that the

ash pit doors are left open at all times while the plant is in operation, therefore it is possible to remove ashes whenever it is convenient without shutting off the blast or making any other change in operating the furnaces.

Mechanical stokers are used to good advantage with natural draft, but it is possible to secure scientific results when they are used in connection with forced draft that is not possible otherwise. The following explanation of Fig. 2 will make this plain. Coal is delivered into the hopper, 2, from a bin that is usually located higher than the boilers, although it may be shoveled

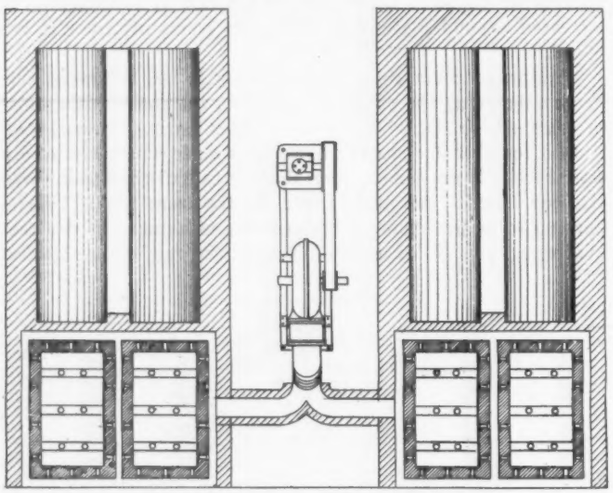


FIG. 5.—TWO BATTERIES OF BOILERS WITH A SINGLE FAN.

into it from the floor if preferred. It is delivered through a gate, 3, by means of which the flow is regulated to suit the demand. It moves very slowly over fire bricks, 4, placed at an angle, and heated to a high temperature. It then falls on to the grates, which carry it backward toward the bridge wall, but it is not always subjected to the same strength of air blast. The space immediately below the traveling grates is divided into five or more compartments. When the coal is moving over 5 it is ready to ignite, hence when a moderate blast of air passes upward it completes the ignition process, and prepares it for more rapid combustion. While moving over the larger compartment, 6, the full force of air causes it to attain the highest rate of combustion and give out a greater portion of the heat it contains. The blast is less in 7 and is reduced still more in 8, while in 9 only a gentle circulation of air obtains, which extracts heat from the hot ashes before they are dumped into the pit. The result of adopting a device of this kind is to increase the capacity of the boiler plant without injury to the boilers, as it eliminates the loss of evaporation due to cleaning fires, also the undesirable draughts of cold air that rush into a furnace when fresh coal is put on by hand. The effect is to give full capacity every minute while the fires are maintained.

Fig. 3 illustrates an upright engine driving a belted fan, which forces air through a large pipe extending across the fronts of a battery of large boilers, out of which the air required for each boiler is obtained. This is not a very convenient arrangement, because this large pipe is in the way of the fireman. However, a mechanical stoker is used in this case, which forces coal into the lower part of the fire instead of spreading it over the top, as with hand firing.

Fig. 4 illustrates the operation of this stoker, showing that when fresh coal is ignited the gases which are liberated by the process must pass through the hottest part of the flames, therefore no chance is afforded them to pass away without being consumed.

A very neat arrangement of forced draft apparatus consists of a vertical engine, which drives, by direct connection, a fan which forces air into a conduit located under the floor, an outlet being provided for each boiler. A direct-connected fan must be larger in diameter than a belt-driven machine, because a certain speed must be secured at the rim of the fan, in order to secure the best results. The use of a belted fan permits the operation of a comparatively low speed engine, which will prove durable accordingly. Of course, engines are made that will run at any speed within reasonable limits, but for practical use in the boiler room of an average plant the safe and hence economical limit is not high, owing to the indifferent way in which such machinery is cared for. If only one engine is installed, trouble and expense are liable to follow, because the whole plant depends on the operation of that small machine.

It is a good plan to provide an extra engine to use in case an accident disables the regular driver. A horizontal engine may be placed on each side of the fan, and a cut-off coupling provided for each, so that either one can be run at pleasure. The special advantage of this plan is that if one is disabled the other can be started at once, thus preventing any delay whatever. With this installation one engine should be run one week, and the other ought to be used the next, in order to keep both ready for instant service. The practice of using one until it becomes unfit for use and then making an effort to start the other cannot be too strongly condemned.

A double engine may also be used for this purpose, thus making it possible to disconnect one side if any of the parts are broken, and using the other until repairs can be made. This is much better than depending on a single engine, but it will take a short time to make the desired change, and this time may be very valuable. If both parts of the double engine are run together it gives very satisfactory service.

If a simple horizontal engine is desired for this service choice should center on one of the enclosed type and provided with a lubricating system whereby the main parts are constantly flooded with oil. These features prevent the dust and dirt usually found in a boiler room from destroying these bearings, and special care is not required to keep them well lubricated. A cheap engine should not be used for this important service, but the best kind made, taking into consideration the service for which it is to be used.

Fig. 5 shows two batteries of boilers, with a pair in each. Forced draft is supplied by means of a fan that is located in a suitable space between them. Each of these boilers is fitted with a Dutch oven for burning waste material of little or no value for any other purpose. Such an arrangement cannot be tolerated if ground space is valuable, but is excellent for service where it can be installed.

Fig. 6 is a side elevation of a water-tube boiler operated under forced draft supplied by a fan that is driven by an electric motor. In a large plant where electricity is always available, this forms an ideal drive, but in a comparatively small plant (especially if it is isolated) it may be inconvenient to start the electric engine solely for this purpose. Air is forced through the horizontal pipe, as indicated by arrows, and

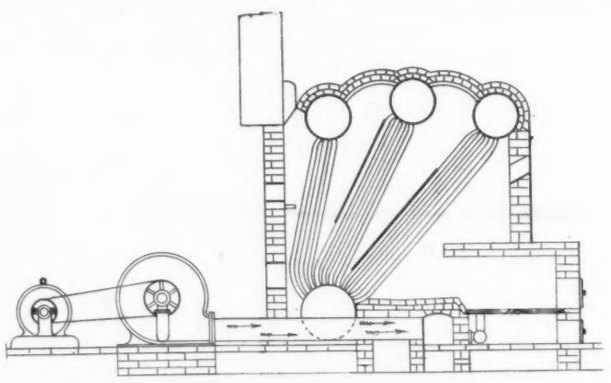


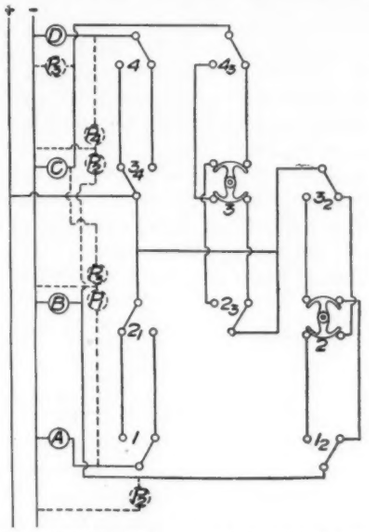
FIG. 6.—MOTOR-DRIVEN FORCED-DRAFT FAN.

discharged into a main conduit located in the bridge wall. It is thus conducted to other boilers in the battery and admitted to one or more ash pits by means of dampers that are operated from the boiler fronts. This makes it necessary to provide tight ash pits, including the doors, as otherwise ashes will be blown out into the room. It is necessary to shut off the blast and practically lay off the boiler when the ash pit is cleaned.

LETTERS ON PRACTICAL SUBJECTS

CONTROL OF HALL LAMPS.

I submit the accompanying diagram as a solution to Mr. C. H. Pool's problem suggested in connection with his solution to Mr. C. M. Johnson's problem in lamp wiring which appeared in the October number. The original problem only asked that the lamps be so wired to switches that a person could light the hall lamps as he ascended and could control them in a reverse



WIRING CONNECTIONS OF LAMPS AND SWITCHES.

order as he descended; but it was not specified that another person should be able to light the lamps as he ascended immediately behind the preceding man. In other words, if the first man went up to the top floor and extinguished the lights and went to bed, another person could not enter and light the way up ahead of him, but must go up in the dark or wait until the other person came down again. Neither could a man stop at either the second or third floors and extinguish the lights.

In the present case the lamps are so wired that the lamp *A* on the first floor can be operated from either the first or second floors by means of the three-point switches 1 and 2, regardless of the position of the other switches. The lamp *B* on the second floor can be operated from the first, second and third floors by means of the three-point switches 1_2 and 3_2 on the first and third floors, respectively, and on the four-point switch 2 on the second floor regardless of the position of any of the switches. The lamp *C* on the third floor can be operated from the second, third and fourth floors by means of the three-point switches 2_3 and 4_3 on the second and fourth floors, respectively, and the four-point switch 3 on the third floor regardless of the positions of any of the switches. The lamp *D* on the fourth floor can be operated by means of the two three-point switches 3_4 and 4 located on the third and fourth floors, respectively, regardless of the positions of any of the switches.

With this arrangement it is possible for any number of persons to ascend or descend in rapid succession regardless of the direction of the course taken by the preceding person. A person can stop off at any floor and extinguish the lights and not interfere in the least with any other person entering the hall and desiring to go in any direction.

To accomplish this it requires eight three-point switches and two four-point switches and the installment of four wires from the first to the fourth floor. The pilot lamps P_2 on the first floor, P_1 and P_3 on the second floor, P_2 and P_4 on the third floor and P_3 on the fourth floor are wired in dotted lines simply as a suggestive method of telling a person which lamps are burning and which are extinguished.

SCHENECTADY, N. Y. F. C. HELMS.

CONNECTING SERIES TRANSFORMERS TO INSTRUMENTS AND RELAYS ON THREE-PHASE SYSTEMS.

The measurement of power on large alternators, busbars and feeders carrying heavy currents at high voltages has been greatly simplified by the use of the series transformer. On the modern switchboard, especially, it has made possible the use of accurate instruments and the elimination of high-tension wiring from the board. Notwithstanding its extreme simplicity of construction, when two or three secondary circuits are interconnected some very peculiar results are obtained, and to the ordinary electrician it seems to be a very intricate arrangement, and it is sometimes very difficult for him to make sure that the connections are right. The blue-prints of the connections may be rigidly followed, but the incorrect setting of one transformer may change the results entirely, and when the circuit is loaded up the instrument may not give any reading at all, or give deflections which are undoubtedly incorrect.

As a general rule, only two series transformers are necessary, especially on a delta-connected system. In fact, three transformers are only necessary when used for relays on a Y-connected system. In nearly every other case two are sufficient, and it is the exception for three to be used. The fact of the matter is that with two series transformers on a three-phase circuit, there are only two possible ways to interconnect the secondaries and in either case only five different places to cut in the instruments; two places giving exactly the same reading as two others, leaving actually but three different places. The connections only become complicated when three transformers are used and it is desired to interconnect all of the secondaries. In Fig. 1 are shown a few different types of series transformers. Assuming that in similar types the direction of winding of the secondary is the same, that shown at (*a*) is probably the simplest. This type is suitable for circuits up to 300 or 400 amp or where the use of bolted lugs are not objectionable. It is easily installed, and the secondary terminals are so located that it is immaterial in which position the transformer is placed. If it is turned end for end the secondary terminals are also reversed. This is also true of the type shown at (*b*), which is equivalent to bending the straight type at the center and bringing the terminals together. The other types are equivalent to bending the secondary winding alone, and if great care is not observed in placing these forms of transformers the secondary

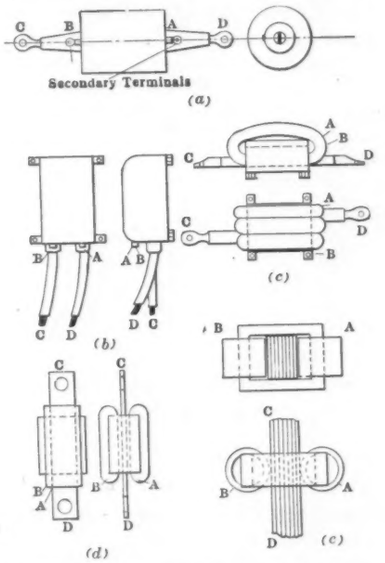


FIG. 1.—DIFFERENT TYPES OF SERIES TRANSFORMERS.

terminals might be mixed. The type shown at (*c*) is also suitable for circuits of moderate capacity where bolted lugs are allowable. The transformer shown at (*d*) is intended for heavier circuits where strip copper is used, and that at (*e*) for heavy busbars, where the two additional joints necessary when using type (*d*) would be objectionable. For type (*e*) the busbar is broken at the nearest joint and the transformer slipped over it.

It is immaterial if the busbar fits exactly or not; that is, it need not go exactly through the center of the aperture.

The ratio of primary to secondary current varies. In some transformers it is as low as 20 to 1, while for busbars of large capacity the ratio is 1000, or even 1500, to 1. The ratio is usually so chosen that at full load the current in the secondary will be 3 or 5 amp. Thus for a 300-amp circuit and a 3-amp instrument the ratio would be 100 to 1; for a 500-amp busbar and for a 5-amp instrument, 1000 to 1 would be a suitable ratio.

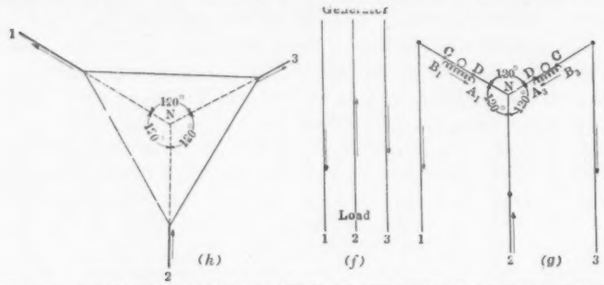


FIG. 2.—TIME PHASE DISPLACEMENT OF CURRENTS IN THREE-PHASE SYSTEMS.

The normal condition of operation of a series transformer is with the secondary short-circuited, or the lower the impedance of the circuit or instrument to which it is connected the more accurate is the transformation. However, for good results it is permissible to run a circuit of, say, No. 12 wire to a watt-hour meter located, say, 100 ft. from the transformer. The wires should never be coiled, but should be run as straight and as direct as possible. For accurate results with indicating wattmeters it is permissible to cut ammeters into the same circuit and where precise readings are not required relays are also introduced into the same secondary circuit; but where accurate records are desired separate transformers should be used for watt and watt-hour meters.

INSTALLING SERIES TRANSFORMERS.

Referring to Fig. 1, types *c*, *d* and *e* should be very carefully installed with reference to the relative position of the two transformers. In three-phase systems it is usual to have all the circuits, busbars, etc., uniform with regard to the three leads; that is, if the circuits are numbered 1, 2 and 3 to have No. 2 always in the center and, looking toward the generator or source of power, No. 1 on the left-hand side and No. 3 on the right-hand side. The transformers are then cut in the two outside leads and the center lead No. 2 will have no transformer in it at all. Any desired combination of instruments may be operated from the two transformers or, if delta-connected, the circuit can be fully protected. If Y-connected the circuit will require three transformers for the relays to protect the circuit from a short-circuit due to a ground. In the latter case a grounded neutral is used. In placing a transformer like that shown at *d*, Fig. 1, if the one is placed with the end *D* toward the generator and the end *C* toward the load, and the secondary terminals *A* and *B* coming out on top, then the other should be similarly placed, because if it should be turned over, allowing the secondary terminals to come out on the bottom, the secondary terminals would be reversed, or, in other words, if one considers *A* the start of the secondary winding looking from end *C* it would be on the left-hand side of the lead, but if the transformer were turned over it would then be on the right-hand side.

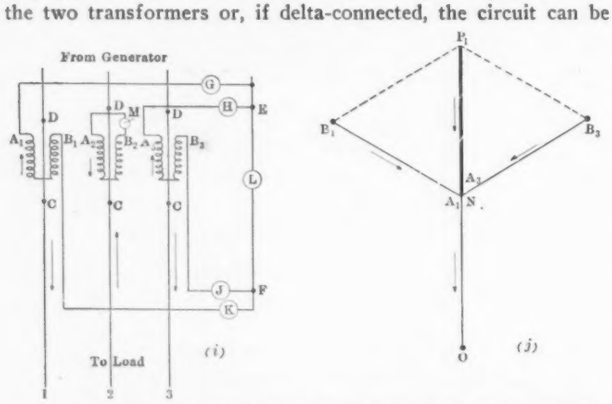


FIG. 3.—SECONDARIES CONNECTED CORRECTLY TO INDICATE CURRENT IN THREE LEADS.

In either a delta- or Y-connected three-phase system the currents in the three leads are displaced 120 deg. from each other, and one of the leads may be considered a common return for the other two, as shown at *f*, Fig. 2. Assuming the instantaneous direction of currents in leads 1 and 3 to be downward, then the direction of the current in lead 2 will be upward. If the system is Y-connected, as at *g*, Fig. 2, the direction of currents would be as shown, that in lead 2 toward the neutral point *N*, that in leads 1 and 3 away from it. Connecting the system in delta does not change this relation. At *h*, Fig. 2, the current in lead 1 is the resultant of that in the two phases 2-1 and 3-1; likewise the current in any lead. By projecting these lines to an imaginary neutral point, *N*, it will be seen that the currents differ in phase by 120 deg.

The current in the secondary of a series transformer is practically displaced 180 deg. from that in its primary winding or directly in opposition. In order to prove by actual measurement that the diagrams given are correct, three series transformers of the type shown at *e*, Fig. 1, were carefully placed on a busbar in exactly the same position, and the secondary terminals tested for direction of winding to locate the correct terminals for the beginning and ending of the winding. Transformers 1 and 3 were then connected as shown at *i*, Fig. 3. The terminals of the beginnings of the windings A_1 and A_3 were connected to a common wire at *E*, the ends of B_1 and B_3 were connected to the common wire at *F*. Suitable ammeters were cut in at *G*, *H*, *L*, *J*, *K* and *M*. The bus capacity was 3000 amp, the transformer ratio 1000 to 1, and the ammeters 3-amp instruments calibrated to give a reading of the exact current in the bus. A load of about 1500 amp was then put on the bus and a reading taken as follows: *G*, 1520; *H*, 1515; *L*, 1520; *J*, 1515; *K*, 1520 and *M*, 1520 amp.

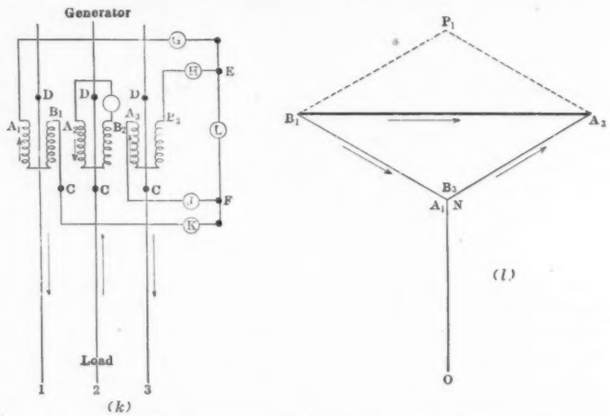


FIG. 4.—INCORRECT CONNECTIONS OF TWO SECONDARIES.

It is evident that ammeters *G* and *K* indicate the current in lead 1, and *H* and *J* that in lead 3, or, in other words, ammeters *J* and *K* are unnecessary. In *j*, Fig. 3, let $B_1 - A_1$ equal the current in lead 1, in magnitude and direction, and $B_3 - A_3$ that in lead 3, which is displaced 120 deg. The resultant current that flows in the common wire $E - F$ will be equal in magnitude and direction to $N - O$, as will be seen by drawing $B_1 - P_1$, $B_3 - P_1$ and the resultant $P_1 - N$, which is parallel with $N - O$ and of the same length. Ammeter *L* indicates the current flowing in the lead 2, and its reading agrees with that of the ammeter *M*.

At *k*, Fig. 4, the connections to transformer 3 are transposed, the transformer being short-circuited while making the change, and readings again taken as follows: *G*, 1480; *H*, 1475; *L*, 2560; *J*, 1475; *K*, 1480, and *M*, 1480 amp. Ammeter *L* no longer indicates the current in lead 2. Referring to *l*, Fig. 4, $B_1 - A_1$

represents the current in lead 1 in magnitude and direction, and $B_3 - A_3$ that in lead 3, and the resultant $B_1 - A_3$ represents in magnitude and direction the current indicated in ammeter *L*. It will be readily seen that this resultant current is displaced 90 deg. from that in lead 2, which is represented by $N - O$, and by scaling the line $B_1 - A_3$ it will be found to be 1.73 times as long as $B_1 - A_1$. This may also be proved by trigonometry, using $B_1 - A_1$ as a unit; $B_1 - A_3$ will be equal to twice the cosine of 30 deg. or the $\sqrt{3}$, which is 1.732.

Transformers 1 and 2 and 2 and 3 were then tested in the same way and similar readings secured, thus showing that any two leads may be used for the transformers, although, as stated before, it is customary to install them in the outside leads.

By connecting as indicated in Fig. 3 and cutting in ammeter at *G*, *H* and *L*, the currents in the three leads will be indicated and transformer 2 is unnecessary; the ammeters will give correct readings on an unbalanced load. If in this method of connection ammeter *L* should give a reading approximately 1.73 times that given by *G* or *H* and the load is known to be approximately balanced, then probably one of the secondary windings is not wound in the proper direction and transposing the connections to either one of the transformers will remedy the trouble.

PHILADELPHIA, PA. F. C. CONRAD.

REGULATING AND GOVERNING THE SPEED OF WATER-WHEELS.

The regulation of steam engines is readily accomplished within 2½ per cent, and under certain conditions, regulation may be effected even closer, but the governing of the speed of a water-wheel so that the variation shall not be more than 2½ per cent between full-load and no-load is extremely difficult. While the steam engine is regulated by cutting off the steam admitted to the cylinder, either in quantity or in pressure, the water-wheel usually has its speed regulated, or the attempt is made to govern the speed by throttling the continuous flow of water which passes through the wheel.

Thus, at the very beginning, regulation is effected in different ways in regard to steam and water prime-movers, for the former uses steam intermittently, and a predetermined quantity can be admitted to each end of the cylinder (in reciprocating engines) at each stroke. In the water-wheel, the flow of water through the wheel is continuous, the work done depending upon the weight and pressure of the flowing water, also upon its inertia and some other things which need not be taken into account here.

In governing steam engines, a comparatively small volume of the power-exerting substance is to be controlled, while in the water-wheel a very large quantity is to be controlled. Again, the substance supplied to the engine is very elastic and being a gas it has practically no weight, therefore very little momentum, consequently its inertia is very little and may be disregarded. Water, on the other hand, is a very dense liquid weighing at least 62 lb. to the cubic foot. This fluid, being practically without elasticity, cannot expand like steam, and when the motion of a moving column is arrested or has its velocity suddenly changed, startling results are often observed as regards the pressure exerted by the moving column, particularly when its motion at high velocity is suddenly arrested either completely or partially.

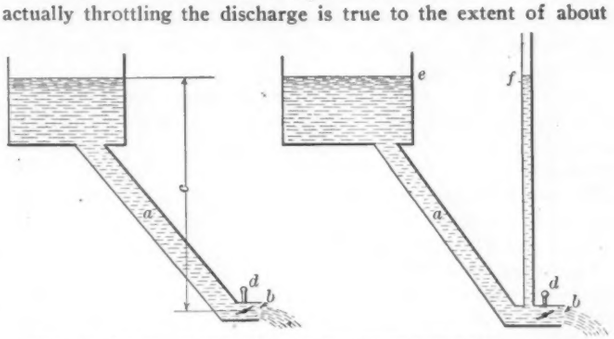
Close regulation of a steam engine is effected by cutting off the flow of steam completely after a predetermined quantity has entered the cylinder. The control of steam engine speed by throttling the steam supply can never be as close as regulation by limiting the quantity of steam which is allowed to enter the cylinder. Water-wheel regulation must be accomplished entirely by throttling the supply, it being impossible to limit the amount used at each revolution as is done with the automatic steam engine. The water-wheel, therefore, must enter the race for regulation with the very heavy handicap of having to be regulated entirely by throttling the water supply.

There is also a further handicap in the character of the fluid which must be throttled. While steam, practically without inertia, is supplied through a small, easily controlled pipe, the water-wheel governor must handle an immense mass of very dense fluid, the inertia and cross-section of which are many times as great as with steam.

The water-wheel must be regulated by partially opening or closing a very large valve or gate which permits a greater or a less quantity of water to flow into the wheel. Whether the gate be a valve in the penstock or whether the turbine guides or chutes be used for this purpose, the effect is the same, a throttling of the water supply, though the latter method is the quickest and most efficient. Still, in either case, the defects here described will always be in evidence.

When a column of water is moving through a pipe or through a penstock, there is acquired a certain velocity of flow which is limited by the head of water and the friction of the column against the sides of the conduit. This selection is illustrated by Fig. 1, in which the column of water *a* is shown flowing through the opening *b*, under the head *c*, and the quantity of water discharged at *b* depends upon the head *c* and the friction of the water in *a*. Let there be inserted at *d* a gate or valve by means of which the cross-section of column *a* may be decreased or contracted. It will be found that the gate may be turned through a considerable angle without diminishing perceptibly the flow of water at *b*. The reason for this occurrence may be found in the theory of the Venturi meter, in which there is a considerable contraction of the flow pipe without appreciable lessening of the flow at the discharge.

The fact that the column may be throttled as at *d* without actually throttling the discharge is true to the extent of about



FIGS. 1 AND 2.—FLOW OF WATER THROUGH CONTRACTED AREAS.

0.9 of the area of the column *a*, but the ratio of 1 to 0.9 will be found to change accordingly as the velocity varies in water column *a*. The reason why such a contraction of area is possible without diminishing the flow at *b*, is due to the fact that the velocity of flow is increased as the passage is throttled by valve *d*, and this increase of velocity forces an increased quantity of water past the obstruction without throttling the flow at *b*.

From the above it will be noted that with a gate at full opening it is necessary to close off one-tenth of the entire column area before the gate will begin to throttle the water supply. It is evident, therefore, that the throttling gate can never be a very sensitive controlling device. There is, moreover, another reason why the valve in a water pipe cannot control the flow quickly. With the same arrangement of head and column as shown by Fig. 1, let a pipe *f* be connected as shown by Fig. 2. The water will rise in this pipe approximately to the same level as in flume *e* (usually there is a small "fall of pressure" depending upon the areas at *a* and at *b*), but let the flow be fully established at *b* and valve *d* suddenly closed and the water will rise in pipe *f*, far above the level of the water in flume *e*. Indeed, by a proper arrangement of the column *a* and valve *d*, and by the addition of an air chamber and valves in pipe *f*, water could be driven many feet in that pipe above the level *e*. An arrangement of this kind is known as a hydraulic ram; a similar action, though to a lesser degree, takes place every time the gate of a water-wheel is closed, wholly or partially, by the action of the water-wheel governor or by hand.

As already noted, the valve *d* can be closed to the extent of one-tenth of the area of column *a*, without throttling the water supply, owing to an increase in the velocity of the stream at the reduced valve section when the valve is further closed;

after the point is reached where throttling of the discharge commences, before the throttling can take effect in reducing the amount of discharge, there is a momentary increase in the velocity of the column, due to the slight ram-action caused by closing the gate. The ram-action effect is manifest in a momentary increase of flow due to the increase of head in pipe *f*, or in pressure at *d*, if there be no outlet pipe *f*.

The increase in flow soon dies out and then the governor gains control of the water column, but an appreciable length of time is required for this purpose—several seconds, at the least. During this time the speed of the water-wheel remains too high, or perhaps is constantly increasing, in spite of the action of the governor; the governor operates slowly by reason of the conditions above noted and is unable to cut down the speed of the water-wheel until it has made many revolutions at a rate of speed which is detrimental to the voltage delivered by the generators which may be driven by the water-wheel.

When the speed of the water-wheel is too low the valve or gate *d* opens in response to the demand for more water in the water-wheel, and the momentary loss of pressure due to increasing the opening at *d*, in column *a*, actually causes less water to issue at *b*. True, the loss of pressure is only momentary, as it lasts only long enough for gravity to start column *a* into full action again, but as the attraction of gravitation can make a body fall only 16½ ft. during the first second, it will be readily noted that an appreciable time must elapse before the full force can be communicated to the column of water at *b;* as the loss of pressure occurs when seconds are of vital importance, the slow action of all water-wheel governors is satisfactorily explained.

The slowness in action of a wheel governor is not due to a defect in the device, but is attributable to well-known natural laws which, perhaps, are not always taken into account when a wheel governor is to be designed; any attempt to bring out a quick-acting water-wheel governor of the throttling type must necessarily result in failure. For loads which do not fluctuate quickly, and where the requisite amount of time can be allowed for governor action, the present types give excellent satisfaction, but in the case of a small street railway generator driven by a water-wheel, no governor of the throttling type yet invented, or likely to be invented, can act quickly enough to hold the fluctuations from full load to no load to a point within 2½ per cent of the normal speed.

As the water-wheel governor is unable to regulate as quickly as desired, mechanical or electrical means must be resorted to when very close regulation is required. The ideal condition for the operation of water-wheels is continuously at full load. Any attempt to operate a wheel under partial gate results in a loss of efficiency, another factor which acts against the rapid action of water-wheel governors. When only half-load regulation is required—from half-load to full-load—and the water-wheel is used in connection with a steam engine, then the problem becomes an easy one; it is necessary merely to couple up the engine to the water-wheel shaft to run a couple of revolutions per minute more slowly than the wheels or wheel would drive the shaft. This arrangement being effected, the wheels will do all the work until they reach the point of full load and decrease in speed slightly, whereupon the engine governor comes into play and the engine takes the balance of the load and does all the regulating within its rating above the wheel-rating.

The connection between the wheel and the engine noted above is a mechanical one through the belt transmission. It is not essential to employ this arrangement, because the connection may be an electrical one and the wheel may drive a generator of its own. In the latter case, the water-wheel runs at full-load, but is controlled by a governor of its own for emergency purposes, such as the failure of transmission, blowing out of fuses, failure of the generator, etc.; the steam engine takes the balance of the load and does all of the regulating.

An instance of this kind exists in a Massachusetts town where the water-wheel is located several miles from the power house of an electric railway and the wheel runs continuously, with only periodical visits at long intervals from an attendant. The stopping and starting of the wheel is electrically controlled from the power house, a distance-controlled motor doing the work of raising and lowering the gate. The same motor which does this work is given control of the gate by the governor after the wheel is running at full speed. The gate-operating motor is connected through a storage battery in order that the wheel can be controlled even if the supply of current be interrupted simultaneously at the water-wheel generator and at the power-house generator.

The above, however, is not wheel regulation and control within the limit set at the beginning of this article. To ensure close water-wheel regulation, it will be necessary to add some appliance which will tend to retard the wheel speed when the governor is closed, and which will tend to accelerate the wheel speed while the governor is obtaining control of the wheel "during a bear movement." So far as the writer knows, such an appliance has not yet been placed upon the market, and it seems that the field in question is a profitable one for invention.

From the conditions to be filled, it seems as if the problem could be solved by the use of a small storage battery, a generator driven from the water-wheel to charge the battery, and a controller operated by the water-wheel governor. Without going deeply into calculations, it would appear that a generator having 5 per cent of the rating of the water-wheel would be sufficient.

The controller should be so connected that the generator charges the storage battery when the water-wheel is running at its regular speed, but the battery is cut off by a relay switch when the cells are fully charged. Should the speed of the water-wheel fall, the water-wheel governor at once works in the regular way; the electric controller is also operative, and as soon as that appliance moves, the charging current to the battery is cut off and the generator is connected as a motor, the whole power of the storage battery being applied to boost the speed of the water-wheel. This action continues until the wheel governor has obtained control and the speed has become normal again, whereupon the controller shifts the connections again to the original position of feeding energy to the storage battery under control of the relay-switch, the field current of the generator being supplied by the storage battery.

Should the speed begin to increase by the removal of load from the water-wheel, or from any other reason, the controller is moved by the water-wheel governor to a position which reverses the current through the motor, which then immediately begins to exert its total force to oppose the force of the water-wheel; by trying to revolve in the opposite direction, it becomes a sort of magnetic brake which assists the governor action in maintaining the wheel speed at its normal value. The proposition seems a simple one with no serious problems to be overcome in the design of the controller. Probably two positions on either side of the normal, or battery-charging, position would be enough, the first set of controller contacts in either direction giving normal power of the generator as a motor, while the second contacts give the motor overload to the limit and very quickly cause the wheel speed to return to its normal value.

There is another method by means of which the speed can be even more quickly controlled under certain conditions. By this method, the speed may be retarded at will, but it cannot be accelerated when decreased by a load suddenly applied. This device is also electrical and should be operated by outside current, or from a storage battery supplied with energy from the water-wheel. It is merely a powerful magnetic brake, either attached directly to the wheel shaft or mounted separately and belt connected. The former method is the better one, for a counter-shaft absorbs about 10 per cent of the power transmitted to the shaft in question. Therefore, the magnetic brake should be directly connected if possible. A controller is necessary, but with the magnetic brake a very rudimentary form of controller will suffice.

Willoughby, Ohio. James F. Hobart.

QUESTIONS AND ANSWERS

Can two constant-current regulators for series arc circuits be connected to a three-phase system by means of the Scott or T-connection? If so, will a slight unbalancing of the arc circuits cause serious trouble?
F. C. S.

The T-connection of two transformers can conveniently be used for obtaining energy on a three-phase system for use in two arc-lamp circuits. The effect of any unbalance in the separate circuits will be exactly the same as though these two circuits were connected to the two separate phases of a two-phase generator. Any slight unbalance will not be noticeable on the generator or transmission system, while the operation of each arc circuit will not be affected in any way by any change in the other arc circuit.

Can a two-phase induction motor be run from two single-phase transformers supplied with energy from a single-phase primary circuit? F. S.

The transformers have no effect with reference to the change in the time phase of the voltage, although they may change the value of the voltage. That is to say, the effect is the same whether the transformers are used or not used. A two-phase induction motor may be started from a single-phase circuit by connecting in series with one winding a certain amount of resistance, the two windings being connected in parallel across the supply system. When started in this way the machine is spoken of as a split-phase motor. When approximately full speed has been reached, the circuit containing the resistance is opened and the machine operates as a single-phase induction motor. It is not possible to operate a two-phase induction motor as a two-phase machine from a single-phase supply system.

Kindly advise us what resistance would be required for use in series with a D'Arsonval movement millivoltmeter having an internal resistance of 0.9 ohm, and which requires 50 millivolts to give full scale deflection. We would like to know the approximate number of ohms to insert in series to obtain full scale deflection at a pressure of 300 volts.
W. R. H. CO.

The problem outlined requires in its solution merely an application of the physical relation expressed in what is known as Ohm's law. An instrument which has an internal resistance of 0.9 ohm and gives a full scale deflection when the electromotive force is 50 millivolts, uses 0.055 amp at full scale reading. In order that 300 volts may produce only 0.055 amp, the total resistance in circuit must be 5400 ohms. For absolute accuracy the external resistance should be less than 5400 ohms by the amount of the resistance of the millivolt meter. The latter amount, however, is entirely negligible in comparison with the total resistance and need not be considered.

An ordinary transformer rated at 1 kw, 100-volt primary and 10-volt secondary is connected up as an auto-transformer to transform from 100 to 110 volts. What is the full-load rating of the transformer so used? What is the full-load output of current? What is the full-load intake of current? What is the full-load current in the 100-volt coil? What is the full-load current in the 10-volt coil?
C. T. V.

With the transformer used and connected as stated, the following results will be obtained: Neglecting the no-load current for supplying the core loss and the excitation, at full load the current in the primary coil would be 10 amp, and the current in the secondary coil 100 amp. The secondary coil being connected to the delivery circuit, the delivered current would be 100 amp at 110 volts, so that the delivered volt-amperes would be 11,000. On the intake side there would be 110 amp, 100 of which pass directly to the load and 10 amp of which pass through the primary coil; thus the value of the input volt-amperes is $100 \times 110 = 11{,}000$. You will find these points fully discussed in the Standard Hand Book.

How may the voltage of a slip-ring motor be determined? Take, for example, a 220-volt, 60-cycle, three-phase motor whose stator is wound for 220 volts and the rotor for 65 volts. How may the voltage on the rings be calculated?
R. H. S.

We are in doubt as to what you have in mind. It is probable that the ratio of the turns on the primary and secondary are as 220 to 65, so that when the rotor is stationary and an electromotive force of 220 volts is impressed upon the primary, an electromotive force of 65 volts would be generated at the slip rings of the stationary (secondary) rotor. This electromotive force would be observed on a voltmeter at the secondary circuit, if the secondary circuit were open. The secondary voltage decreases directly with the speed and reaches zero when the speed is synchronous. Thus at one-half synchronous speed the electromotive force on the slip rings would be 32.5 volts. If, however, the secondary circuit is closed through a resistance, the full value of the electromotive force would not be observable on account of the loss of voltage in the secondary winding. With a slip of not more than 5 per cent, the observable secondary electromotive force would be about 3 volts, and with the secondary closed through a circuit having an impedance equal to the impedance of the secondary circuit of the motor at the above speed, the observable electromotive force at the slip rings would be one-half of this value, or about 1.5 volts.

It is desired to test a number of 550-volt, three-phase induction motors ranging in rating from 10 to 100 hp, for power developed. If an ammeter and voltmeter are connected in circuit and the efficiency of each motor from the percentage of load as furnished by the makers determined, using the power factor of the circuit as recorded at the generating station, will the result be as accurate as if measurements were made with wattmeters?
E. B.

The method suggested cannot possibly give as accurate results as a test made with the usual instruments, and it is very probable that the results will be largely in error. A reading of instruments at the generator shows the power factor of the whole load on the generator, and unless the particular motor tested happened to be the only load at that time, the power factor reading would have no connection whatsoever with the actual power factor of the motor. There was published in the ELECTRICAL WORLD AND ENGINEER of Jan. 11, 1902, a description of a complete test of an induction motor by the use of only one wattmeter and a voltmeter, and it is probable that this article will supply you with the desired information.

A German shunt-wound, bipolar, ¾-hp machine was rewound, and while formerly the machine took about 5 amp or less, it now takes as high as 60 amp at 220 volts. The coil throw is 14, and there are 29 slots in the armature. The old coils were not form-wound, but were simply wrapped on. New form-wound coils were substituted, and as there were 20 turns of wire approximating in size No. 21 in each coil, 20 turns of No. 22 wire were used in the new form-wound coils. The machine runs at a very high speed and has no power. What can be the matter?
P. G.

It is doubtful whether the information which we are able to give you concerning the trouble encountered by you in rewinding a certain motor will be of any service to you, because you have probably failed to give us any clue as to the source of trouble. If the coils are taken from the armature of a motor and coils having the same number of turns are substituted therefor, the speed of the motor when operating at no load would not be changed in any respect by reason of the fact that the size of the wire in one case was different from that in the other case. The fact that the motor rewound by you tended to operate at a speed higher than normal shows conclusively that the rewound armature is connected in such a way that the effective number of turns is less than formerly. The machine operates as though the coils had previously been connected in series, and are now connected in parallel. That is to say, if the motor were driven as a generator with separate excitation obtained from 220 volts, it is extremely probable that when the armature speed has its normal value the armature electromotive force will be not over 50 volts instead of 220 volts. We suggest that you make such a test as this. If the results are as indicated above, then there can be no doubt that the interconnections of the armature turns are incorrect. It is possible that the results which you have obtained could be caused by the brushes being in the wrong position on the commutator, but it is very probable that you have shifted the brushes to all possible positions. In just what way the armature should be wound we cannot say without having full information concerning the previous arrangement of the armature conductors.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Distribution Costs in Seven Central-Station Systems.

One of the most attractive fields in which to study power losses is in central-station distribution. The discrepancy between the amount of electrical energy generated in a modern central station and the amount of energy accounted for in sales represents in some cases a very considerable percentage. The following figures deduced from the returns of seven large companies in Massachusetts to the Board of Gas and Electric Light Commissioners for the year ending June 30, 1908, emphasize, not the relative operating efficiency of the companies taken, but the importance of studying the distribution problem year by year in all progressive systems. A direct comparison between the companies is not so much intended as the accentuation of the wide differences in cost of distribution in the same territory, roughly speaking.

The companies selected are the Edison Electric Illuminating Company of Boston, the Worcester Electric Light Company, the Lowell Electric Light Corporation, the Fall River Electric Light Company, the Malden Electric Company, the Cambridge Electric Light Company and the Lynn Gas & Electric Company. With the exception of the Boston Edison organization, the greater part of the output of these companies so far as transmitted any notable distance from the station is carried by 2300-volt circuits, although a small amount of 500-volt service still remains in some cases. The Edison Company, as is well known, transmits power to a number of outlying substations at a potential of 6600 volts, besides serving the heart of the city with three-wire current at 220 volts between outers, and supplying alternating current at 2300 volts for miscellaneous commercial service.

The items entering the cost of distribution are wages for the care of lights and meters, clerical labor in this department, and salary or commission of collectors, repairs and renewals of lines, repairs and renewals of meters, lamps and motors, distribution tools and appliances, carbons and incandescent lamps. The following table gives these items, together with the total kw-hours generated and the total sold, and the total cost per kw-hour sold.

	Boston.	Worcester.	Lowell.	Fall River.	Malden.	Cambridge.	Lynn.
Kw-hour manufactured	88,535,490	5,400,192	9,426,511	4,061,284	4,647,453	6,043,204	8,776,166
Kw-hour sold	60,798,606	4,530,464	6,746,044	1,819,225	3,423,469	5,334,402	7,141,359
Meter and collection	$10,511.83	$15,265.03	$8,300.45	$27,978.98	$10,840.93	$26,172.79	$17,405.85
Repairs, lines	$165,706.56	$18,606.69	$30,821.86	$10,287.42	$35,953.20	$6,354.26	$47,584.23
Repairs, meters, etc.	$44,786.61	$4,534.49	$2,914.73	$4,448.98	$2,414.03	.....	.....
Dis. tools	.....	$1,112.66	.....	$829.61	$11,635.40	$105.92	$736.33
Carbons	$41,354.04	$2,006.39	$832.15	$5,071.59	$702.59	$987.78	$1,405.57
Incandescent lamps	$152,461.53	$6,542.04	$9,373.96	$10,244.68	$9,419.63	$5,789.65	$3,824.38
Total	$414,820.57	$51,240.10	$52,243.15	$58,861.26	$70,965.78	$39,410.40	$70,956.36
Cost per kw-hour sold	68 ct.	1.13 ct.	.775 ct.	3.24 ct.	2.07 ct.	.74 ct.	.995 ct.

In examining the above table it should be borne in mind that some of the items are not proportional to the amount of electricity sold, but are dependent upon such local conditions as the amount of underground wire in service, the area and characteristics of the territory served, the type of lighting system and circuits in operation, relation of initial line and cable capacity to the ultimate load expected in a given district, weather conditions encountered during the year, etc. The Worcester Electric Light Company, for example, has replaced its original street-lighting arc service by the luminous-arc system, which undoubtedly accounts for the small cost of carbons during the year. This company also has a large investment in underground service equipment. In the case of the Boston Edison Company it is safe to say that the voltage used on its suburban transmission circuits allows a very economical line loss under present conditions of loading, and considerable room for expansion of business has been provided for in the design of these lines, which in the most remote transmission, reach a point about 25 miles from the main generating plants. The Edison Company also has special facilities for analyzing its distribution losses from time to time, as explained by Mr. L. L. Elden a year or two ago in a paper before the Boston Branch of the American Institute of Electrical Engineers. Smaller companies cannot expect to reach the same economies of distribution as great organizations selling very large outputs, but they can analyze their conditions to advantage, nevertheless.

Low Rates as a Factor in Acquiring a Day Load.

By T. F. Reardon.

While every central-station manager is anxious to secure patronage during that portion of the 24 hours that a very considerable portion of the plant equipment is either idle or operating on light load, yet the methods employed for the attainment of this object in the majority of cases are not conducted on what can properly be termed a logical basis. Advertising and soliciting are all right, as far as getting the attention of prospective customers. It is clear that the advertisement must be read and the solicitor must be seen and heard as a preliminary in the matter of business getting.

The central-station manager who is really desirous of securing a profitable day load for his station should carefully consider the fact that during non-peak hours certain expenses, such as taxes, interest on invested capital, superintendence, etc., are as great as though the peak load was a constant quantity. Under such conditions, and during such hours, no load should be declined that is capable of yielding any profit to the station, however small such profit may be.

There are many central-station managers who are alive to their own interests in this matter and who arrange the price of energy so that while the station is working up to nearly its normal load and a modest profit is earned on the sale of energy at a special price during such hours, business is secured with far less effort and expense, and the business so secured is liable to prove permanent in character.

Advertising and the solicitation of new business have been raised to the dignity of a leading specialty as far as engaging the attention of the patron is concerned, but at this point it is what is offered by the central-station manager that will determine whether the attention of the prospective customer has merely been engaged or whether his business will be secured.

Central-station companies could well afford to follow the example set by street-railway companies in regard to reduced fares during the hours that the army of workers are being moved and also have regard for the exceedingly low rates offered by telegraph and telephone companies during the hours of the night, the effect of both resulting in a volume of patronage that could be secured in no other manner. The price of energy should be put down to the lowest mark that is consistent with a living profit during the hours that station apparatus is operating wastefully at a light load. Popular prices and a large volume of business are the keynote to success in business ventures at the present time. The electric street railways of the country with

their popular prices and their cars that are normally overloaded afford a striking exemplification of the fact that, while the steam roads with their higher prices for passenger transportation are in hard straits, the growth and development of the electric road is really phenomenal.

The same key to the business situation has been grasped in the theatrical world. It is not high prices and a limited amount of business that pave the way to success, it is a price that will secure the patronage of the masses. The article is not catering to the consumer wholly by any means. It voices a sentiment that means the difference between success and failure in many instances.

For small motors in domestic use energy should be furnished at such a reasonable rate that the solicitor should have no difficulty at all in securing orders. Such apparatus as sewing machines, washing machines, ice-cream freezers, as well as flatirons, tea and coffee pots, etc., should be supplied with energy at such a reasonable rate during certain hours of the day, and during a greater number of hours per day during the summer season, that it should require practically no argument or representation to secure an order.

Electricity should be made to sell itself; under present conditions in all lines of trade there is so much of that formality known as solicitation and representation that the price of nearly every commodity is unnecessarily increased. To abandon advertising and solicitation would be very unwise, and without doubt would be suicidal to business interests, and nothing of that kind is advocated. It is the object of this article to lay stress upon the fact that the central station must aim to have something good to offer to the public. Printers' ink simply puts the various propositions in a large window for display and for the purpose of engaging the attention of the public. If orders do not come in it is not the fault of the advertising medium in any sense of the word; it is because the prospective customer does not believe that the sign of equality can be written between the commodity or service and the stipulation that is required in exchange for it.

When such is the case, advertising and soliciting are employed under very adverse circumstances, and if the central-station man reaches the conclusion that advertising does not pay, he is undoubtedly right in his opinion, but if he would submit the proposition to a more rigid analysis he might find out in what particular cases it does not pay, and why it does not pay.

A Study of Residence Lighting.

One of the most interesting papers presented at the annual meeting of the Association of the Edison Illuminating Companies at Lenox, Mass., gives the conclusions following 10 years' study of residence lighting, particularly in Detroit. The paper expresses the views of the business and metering and accounting departments of the Edison Illuminating Company of Detroit, and is of such composite origin that no author's name is attached to it.

Ratio of Connected Load to Demand.—The connected load of lamps alone is found in groups of old-fashioned residences wired more than 10 years ago to be in relation to the maximum demand of the group, very closely 4 to 1. In groups of residences recently built, the ratio is approximately 5 to 1. A representative group of 905 residences, built within the last 10 years, showed on test a ratio for the group of 4.7 to 1. The increasing ratio of connected load to demand in residences more recently built is found to be due to the greater number of convenient lamps installed; that is to say, lamps not required for general illumination, but used occasionally. Architects now specify such lamps in all closets, on all stairs, in attics, storerooms, etc., and cheaper wiring, cheaper snap switches and lower rates are responsible for this change in wiring practice.

Period of Maximum Demand.—The daily maximum demand of such a group appears to be fairly constant from mid-October until the end of January. The maximum demand for the two weeks immediately before Christmas does not seem to be quite so large as the demand for November and January. The difference between the maxima of the three mid-winter months is, however, very small. The maximum does not change very much throughout the year. Demand indicators installed in 100 residences showed marked reduction in the demand only in June, July and August, and the lowest reading is 75 per cent of the winter maximum. Of course, as noted later, there is a considerable reduction in the energy used during summer months and the maximum is later in the evening.

Hour of Maximum Demand.—The hour of maximum demand of a residence district has never varied in the observations made. It has always come about 15 minutes previous to the time of the evening meal; that is to say (in towns where the standard time and the sun time coincide fairly well), the maximum demand in a residence district will come at about 6:15 p.m.; continue until about 8 p.m., and fall slowly till 10:30 p.m. The residence district demand comes later than the business district maximum, and is falling at the time that the demand due to theaters and other places of entertainment is rising. The sequence is obvious. Lamps are turned out in

FIG. 1.—A STREET IN EVERY HOUSE ON WHICH ELECTRIC LIGHT AND A FLATIRON ARE USED.

offices when people go home for supper and people don't go to shows until after supper. The maximum in residences tends to coincide with the latter part of the demand for energy for the street cars, which carry people from their offices to their homes; precisely as the maximum of the business district tends to coincide with the first part of the street railway evening load. This sequence also is obvious. The street cars are loading in the business center at the time when people are closing their offices and store-rooms and the street cars are arriving in the residence district at the time that the evening meal is being got ready for the home-comers. That the maximum call for street-car energy comes later in the outlying districts than in the business center is a common observation.

Exceptional Cities.—Of course, there are exceptional cities. The observations apply to the general run of American cities and are correct for the outlying areas of the exceptions. But Washington, for instance, has a well defined period of maximum demand in its fashionable residence district during the session of Congress; while Manhattan Island, with its peculiarly congested conditions, requires to be analyzed as half a dozen cities instead of being taken in bulk as one.

Period of Maximum Sales.—The period of maximum sales to residence business is the mid-winter period. The annual curve of units sold for lighting coincides with the curve showing the daily hour of sunset. Washington seems to be the only American city where this rule does not apply. In Northern cities, those districts containing the largest residences—the residences of people who can and do go away during the bitter months of spring—show an unseasonable decrease of sales during February and March. But a residence district so large as to include a majority of middle-class residences always shows sales increasing as the sun sets early and conversely decreasing as sunset becomes later. The December sales in a middle-class district will be 13 per cent to 14 per cent of the annual sales.

The monthly sales during mid-summer may be 4 per cent or 5 per cent of the annual sales.

The accompanying table shows the distribution of sales to 102 residence customers fairly representing one company's average residence business for the 12 months of the year 1907. It will be noted that the monthly sales decrease from 10 per cent in January to 4.2 per cent in June, from which point they again increase to 13.2 per cent in December. The total sales for the six months, April, May, June, July, August and September, amount to 36 per cent of the total annual sales. The other 64 per cent is sold during the six winter months. The price per unit varies almost inversely as the sales, ranging from 9.0 cents per kw-hour in June to 5.7 cents in December.

DATA ON 102 RESIDENCE CUSTOMERS FOR THE YEAR 1907.

Month.	Kw-hours.	Net bills.	Cents per kw-hour.	Per cent of total units for year.
January	3,874	$250.01	6.4	10.0
Februray	3,222	220.60	6.8	8.4
March	3,068	223.75	7.2	8.0
April	2,638	197.87	7.5	6.9
May	2,357	190.11	8.0	6.1
June	1,625	156.71	9.0	4.2
July	1,731	155.54	8.9	4.5
August	2,097	167.11	7.9	5.5
September	3,410	225.20	6.6	8.9
October	4,846	291.10	6.0	12.6
November	4,519	274.34	6.0	11.7
December	5,079	293.25	5.7	13.2
Twelve months	38,466	$2,645.59	6.8	100.0

These comparative values are being changed by the use of fans, flat irons and other electrical devices adapted to household use. The summer fan load is very perceptible in the business of Southern cities. In Detroit the average 6-lb. household iron, it is found, adds about 10 units per month to the number of units per residence, and this addition is practically uniform from month to month throughout the year. When it is not uniform it is because the electric iron is used only in the summer months, and such cases, added to the summer use of fans, tend to increase the number of units sold at the time of the year when the company is most willing to make sales.

Annual Load Factor.—Studies of 10 years ago showed an annual load factor corresponding to 830 to 840 hours of the district demand. Studies of the last two years show that the annual load factor is approximating a value of 1000 hours' use of the district maximum. The district of 400 residences on which the studies 10 years ago were made and which permitted of very exact conclusions is now tied into the general system and has much commercial business mixed in with it. But the group of 905 residences mentioned earlier, all of them being houses built in the last 10 years, appears to have a load factor equal to an annual use of the district maximum for 977 hours, and studies of a group of 100 residences (no flats included in this group) in which separate demand indicators were installed and records kept for 17 months confirm the conclusion that the annual use is approximating 1000 hours. This is not annual use of the aggregate of the demand indicator readings of individual customers. For the 100 customers referred to it is virtually 700 hours. The diversity factor connecting district demand with the sum of the individual demands is therefore apparently 1.4 for such a group. The diversity factor connecting the demand of residence district of any city with the general demand is presumably of a good value in every city because of the late arrival of the hour of maximum demand.

Character of Business.—Residence business is very stable. In times of financial stringency residence customers may economize a little, but they do not order their installations disconnected. When, as in Detroit, the residence rate is differential, such economies are not perceptible. During the past winter, when the sales of energy for motors were much reduced and the sales for commercial lighting were below expectation, the energy used in residences showed no change. The same observation has been made during earlier periods of business depression. Payment from residence customers is prompt. Losses by bad debts are very small, and the business is to a large extent self-propagating. If in a cottage district one man changes from kerosene oil to electricity, half a dozen of his neighbors are sure to make application for service within the next three months. The same condition exists with flat irons. If one woman who does her own housework purchases an electric iron, three or four of her neighbors will apply for irons on trial before two weeks have elapsed. In large and high-class residences, gas has ceased to be a competitor. Among the middle-class residences, the great difficulty is the first cost of wiring, and it is wise to encourage cheap wiring of houses when built. In Detroit the cottages are literally being weaned from kerosene oil to electricity. An essential point seems to be that the cottage shall be occupied by its owner. Detroit has many districts of cottages and of rows of small houses, which are called "terraces," where each cottage or apartment is owned outright or is being purchased on the instalment plan by its occupant. Such householders prefer electricity at an advanced cost over gas or kerosene oil because of the saving in the maintenance of wall paper and ceilings. There are several large property-holders in Detroit who specify in their rental leases that electricity shall be used exclusively for lighting by their tenants. This policy has been adopted by them without action on the part of the electric light company.

Reaction Under Reduced Rates.—Residence lighting responds to a reduction of rates to the extent that a certain number of householders who previously did not think they could afford to use electricity will apply for service on the announcement of any given reduction down to a certain point. Below that point the response will be less because the rate is already low enough to bring the business. It is not necessary to meet competitive prices, since electricity at a higher cost is preferred to gas. The advantages of a horizontal reduction in rate cease when a point is reached where the cost of satisfactory electric lighting is 10 per cent or 15 per cent greater than the cost of gas lighting. The company in Detroit is of the opinion that its last rate reduction carried its residence price lower than was necessary. The business does not respond to a horizontal reduction of rate, as do certain lines of commercial business, by a more lavish use. The prompt switching out of unnecessary lamps is a pet economy of the good housekeeper and no reduction in rate will induce her entirely to relinquish this particular evidence of thrift. However, as the rate decreases and approximates the cost of gas or kerosene oil the housekeeper will permit the servants to use the electricity and will tolerate the continuous burning of porch and back-stair lamps.

Response to Differential Rate Method.—The housekeeper will respond to a proper differential rate method by using household conveniences such as electric flat irons, fans, cooking utensils, sewing-machine motors, washing machines and a certain amount of electric heating. She will not use these things at a straight 10-cent or 9-cent or 8-cent rate, but if her electric light bill is so framed as to give her the average rate which local competitive conditions require, by a differential billing which charges a low rate for energy in excess of the absolutely necessary lighting, then she will use these conveniences. If her rate is 8 cents per kw-hour straight for an average of three-hour daily use, and the same for all additional uses, she will not take to those additional uses; but if her rate for the three-hour service is 16 cents for the first hour and 4 cents for all additional service, her instinct recognizes the bargain and she will use flat irons, and fans, and curling tongs, and chafing dishes, and warming pads and as many other things appropriate to good housekeeping as she thinks she can afford to buy. Householders, however, will not stand for alterations of wiring to provide separate circuits for these conveniences even to obtain a low rate on a separate meter. To be conveniences they must be conveniently attachable anywhere throughout the house. Many housekeepers take delight in doing in their own chambers the ironing of garments which they will not entrust to the tender mercies of their regular laundress. If these desirable devices are to become part of the every-day equipment of the middle-class household, a differential method which will automatically

charge the proper rate for this desirable business, is absolutely essential.

Detroit Differential Residence Rate.—The peculiarity of the Detroit residence rate lies in the method used to determine the amount to be charged to each customer monthly at the primary rate. The theory of the differential rate as laid down by Dr. Hopkinson and by Mr. Arthur Wright requires that the fixed charge to be collected shall be proportional to the investment necessary to serve the customer. The original Hopkinson method includes the profit in the fixed charge to be made by the supply company and collects that fixed charge as an annual payment; and in addition, a charge by meter for each unit supplied, which latter item represents the operating expense. In the Wright demand system the proposed profit per unit sold is added to the price per unit charged by meter and the charges which are proportional to investment are collected by requiring a higher price per unit for a certain number of units in each monthly or quarterly bill. Obviously the last item can be collected either in the form of a high price for a few units in each bill or as a lower price for a greater number of units. Its annual sum, however, must be proportional to the investment necessary to serve the customer.

The Wright system, or more properly the Wright method, of collecting the fixed charge proves to be more convenient than the Hopkinson method in dealing with all retail or non-contract customers, and residence customers naturally fall into that category. In planning a differential rate method for such customers, a lighting company finds itself compelled to place the high or primary rate at a figure not exceeding the existing maximum rate. Logically a rate higher than the existing maximum might be proper. Practically any announcement of such a rate would be criticised as being a raise of price and it is a fact that no company adopting the differential method of charging has placed the primary rate higher than its then existing maximum rate per kw-hour. The Detroit company, recognizing this limitation, placed the primary rate at the same figure as its then maximum meter rate, namely, 16 cents.

There remained to be settled the question of how many units per month should be paid for by any customer at 16 cents before the secondary rate of 5 cents (later 4 cents) should become effective. It was easy to ascertain the proper figure for all the residences served, taken together. These were actually some 400 residences ranging from middle-class to high-class and served from a substation of whose output the residence load was very much the greater part. Such other business as was served by this substation—a few stores, a number of churches and a very trifling amount of motors—was easily isolated and the characteristic load curve of the residences determined within narrow limits of precision. But this figure was a district figure—not a figure for the individual customer. It was simple to ascertain the proper fixed charge for the entire district, but thereafter to apply the rule requiring that each customer should pay a share of that fixed charge proportional to the investment required to serve him, was more complex. The Wright method, then in great vogue, would have prescribed that a demand indicator be installed on the premises of each residence customer and that the distribution of the fixed charge for the district be proportional to the readings of the respective indicators. There was the obvious alternative of making the distribution pro rata to the connected load of each customer. Another alternative which was given brief consideration and dismissed as impracticable under the conditions of a Michigan city, was to distribute the fixed charge pro rata to the assessed valuation of the respective premises. A method practically identical to this has been recently adopted in Norwich, England; but the determination of rateable value of English premises is much more precise than is the tax assessment of any American city; and many matters besides taxes are habitually adjusted in England by reference to the so-called rateable value. The method which was adopted in 1898 was to distribute the fixed charge of the district among the different residences pro rata to the number of rooms in each house.

The objection to the installation of demand indicators is not only the expense of instruments and of reading them, but that the indication given by those instruments bears no true relation to the investment necessary to serve each customer. The investment in a residential district is determined by the district maximum which comes at the hour of the evening meal. The ordinary maximum of each individual customer comes daily at the same hour. But the occasional maximum demand of the city residence customer comes at the time when he entertains company on a large scale, and for a time turns on every lamp in the house. Now, according to the established custom of the American householder, such an entertainment is always later than the ordinary hour of the evening meal; and the guests whose presence calls for the extraordinary illumination are presumably occupants of other electrically lighted residences and because they are not at home have for the time being ceased to use their share of the investment required by the district. The company actually determined that the occasional complete illumination of one of its customers on the occasion of his giving a party was offset by lamps turned off elsewhere in the district by his guests. Obviously the demand recorded by an indicator would be that due to an entertainment, falling not only at an hour later than the district maximum, but compensated for by less demand elsewhere. Therefore, the demand indicator readings could not serve as an equitable rule for the distribution of fixed charge. They would cause the occasional entertainers to pay more than their share while the people who never entertained would correspondingly pay less.

A similar objection lies against a distribution pro rata to connected load. Such a distribution would penalize convenience lamps, such as lamps in closets, attics, basements and storerooms only occasionally used and for short periods. It would also penalize such devices as electric fans, flat irons and all kinds of decorative lighting and, by discouraging such connections, minimize the convenience which is one of the great advantages and best selling points of electric lighting in residences. It would overcharge the man who used electricity intelligently and would favor the man who installed the minimum number of lamps. It was noted particularly that it would discourage a practice which the company was then trying to foster, namely, the wiring of servants' quarters for electric lamps. The lighting of servants' quarters comes later than the district maximum and therefore tends to improve the load factor.

FIG. 2.—RESIDENCE DISTRICT IN WHICH 2517 HOMES OUT OF 3000 ARE LIGHTED BY ELECTRICITY.

The method selected, namely, distribution pro rata to the number of rooms on the premises, is admitted to be empirical, but it proves to be not only equitable as between customers, but to have several commercial advantages. One of these obviously is that the rating of premises can be reproduced at any time by simple inspection. It is also but seldom subject to change, and such changes as occur through the building of additional rooms or the internal alteration of large old houses are called to attention by the request for additional service and lamps. Moreover, since from the very beginning the company declined to consider, in rating a house, whether it was wired in part or throughout, the tendency of the method was to encourage complete wiring as distinguished from the wiring of company rooms, such as the parlor and dining room, while the remainder of the house was left to gas or kerosene oil.

As to the equity of the method it should be noted that the company does not count unfinished attics, storerooms, laundries, closets or bathrooms. It ascertained by many observations that the number of lamps likely to be burning in any residence at the hour of district maximum was actually very closely proportional to the number of living rooms. The company admits that there are exceptions to this, but only such as will be found to any practical rule.

Results in Detroit.—The residence business, as already indicated, responded promptly to a differential method which established on existing business a rate of about 11 cents in competition with gas at $1 per 1000 cu. ft. The changing character of the business as indicated by the improved load factor, and the reductions made from time to time in the number of units charged at the high rate, and by the change of the secondary rate from 5 cents to 4 cents, brought the residence rate in Detroit down to an average of 6.8 cents per kw-hour last year. Reference to the accompanying table shows the variation of this rate during the months of 1907. In the opinion of the company this was low enough, even in competition with good gas at 80 cents per 1000 cu. ft. A change of the primary rate from 16 cents to 14 cents per kw-hour, made July 1, 1908, as part of an agreement with the city still further reduces the average rate. As far as getting business is concerned, the company claims that this latter reduction was unnecessary, and it would have preferred to avoid it. At 6.8 cents average the company was getting the lighting of all the good residences in town, all of the middle-class residences and many of the small residences which are not usually looked upon as possible users of electricity. The photographs accompanying the paper, and one of which is reproduced herewith, make this evident. The residence district is served by overhead wires, and therefore the investment cost is much smaller than in cities where the distribution is underground. There are also many blocks in which every house is lighted by electricity, and there is also, at present, in consequence of the low rate, a large amount of wiring of old residences going on, so that the company is now filling up the vacant places in its circuits. When these vacancies are filled the company contends that even the present low rate will be justified. A rate of 20 cents or 25 cents per kw-hour for service to a few scattered residences would obviously be unprofitable. An average rate of 6 cents per kw-hour is profitable when every residence in each block is served and the rapidity with which additional residences are being connected indicates progress toward that desirable end.

Advantages of a Differential Rate.—In earlier paragraphs some of the advantages of a differential rate method as applied to residences have been noted. To realize all the advantages of the method there must be a considerable difference between the primary and secondary rates. It is well that the primary rate should be three or even four times the secondary rate. In most plants a rate schedule, based upon the Wright analysis of costs, will have this desirable characteristic; but in many cities the established maximum rate is so low that the secondary rate must be disproportionately high in order to make the necessary average earnings per unit sold. In changing from a straight rate to a differential rate it is desirable that the number of units to be paid for monthly at the maximum rate should be such that the householder using light with ordinary economy will have on every bill some units at the secondary or low rate, excepting only the mid-summer bill. The appearance of the low rate on the bill puts the householder on inquiry, and when he realizes that he can double his use of energy and yet only increase the bill by one-quarter or one-third he quits the use of gas or kerosene and looks with favor upon the use of electricity for purposes outside of lighting.

It must be obvious that if doubling the use of electricity only increases the bill by 25 per cent or 33 per cent there will be a reduction of complaints about large winter bills. The Detroit company has never had a complaint from a residence customer about high average rate for summer bills and the first application of the differential rate was followed by a remarkable reduction in the complaints as to big winter bills. Comparing its experience with that in other cities where a straight residence rate is made, even where the rate made is not much higher than our average, it finds that it has proportionately very few of these winter complaints.

In a preceding paragraph was noted the advantage of a differential rate in that it automatically makes the proper rate for miscellaneous heating and small motor services. To this must be added that there are considerable possibilities in the small motor service. Small refrigerating machines are made which are suitable for large residences. So also are small vacuum cleaning machines. The common hot-air heating system—a furnace with an air chamber surrounding it, the air chambers being connected to flues terminating in registers to different parts of the house—is tremendously improved by using a small electric fan to force the circulation. A 16-in. fan of the desk type is sufficient for an ordinary 10-room house. Such a fan mounted in a ring in the same manner as larger ventilating fans is regularly made for the purpose. Economical housekeepers switch off the fan when the wind is on the right side of the house to give good, natural circulation. The domestic clothes-washing machine has arrived and is coming into general use.

Residence Metering.—There is a relation worth noting between the differential rate method and meter efficiency, namely, that the cost of the meter slip is minimized. A residence meter must not burn out when all the lamps are turned on, but the ordinary load is one-fourth or one-fifth of all the light and in many houses one or two lamps of low candle-power burn all night. A meter is required having the incompatible qualities of great overload capacity and accuracy at very light loads. On the alternating-current circuits in Detroit a compromise of these requirements is in use, the earlier type K, Fort Wayne 10-amp meter—not the later high-efficiency type. This meter is correct with one 16-cp lamp and is quite safe, although slow, with 100 per cent overload, which overload represents the turning on of all the lamps in an ordinary 10-room or 12-room house. On such an overload the high-efficiency meter will burn out. Obviously such a meter staying in service two or three years without adjustment fails to account for some energy used at very light loads or during occasional overloads, but this unmetered energy is electricity which under the operation of the differential rate would be charged for at the minimum rate, so that the loss by meter slip is a minimum, and a minimum expense for meters, both in first cost and maintenance, is justified. This is important in residence lighting as with all small consumers. Even now, it is claimed, the cost of metering is too large an item in the investment necessary to serve the small residence customer, and in order to take the business of still smaller residences, now offered to it, the company must find some way to reduce the present meter expense. In this light it is clear that separate metering for service other than for lamps is not desirable nor practicable.

The conclusions reached are as follows: The expression "residence lighting" being intended to include all service to residences; residence lighting has an annual load factor corresponding to 1000 hours' use and improving; a ratio approximately 1.4 to 4 for the sum of the individual monthly demand

indicator readings of a group of 100 or more residences against the combined demand of the group; that is to say, a diversity factor of 1.4; a high diversity factor against office buildings, wholesale houses and factories, coming later in the evening than these classes of service.

Residence lighting is not subject to any competition in large and expensive residences; will carry a price 10 per cent to 20 per cent higher than gas in medium residences and is a competitor of gas and kerosene oil for the lighting of very small residences occupied by their owners.

Residence lighting is desirable when the distribution investment can be minimized by overhead construction; by comparatively cheap meters and by the operation of a rate schedule which secures sufficient density of service; that is to say, a sufficient number of customers in each block supplied.

Residence lighting rates should encourage the use of all electric appliances adapted to residential use without requiring the separate metering of energy for such appliances.

INTERIOR WIRING AND ILLUMINATION

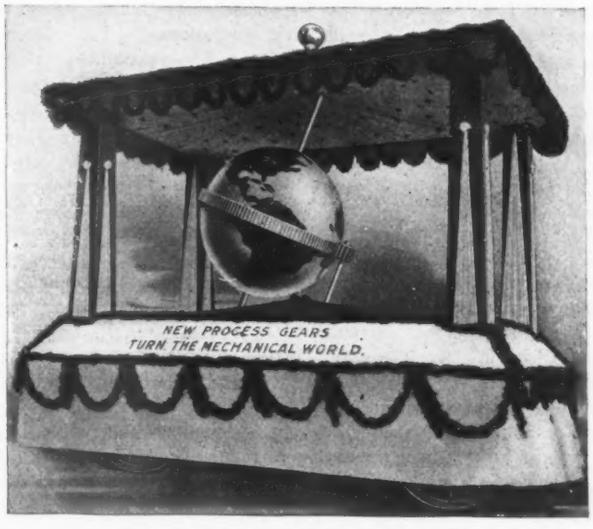
Effect of Ceiling and Wall Color on Illumination.

The paper entitled "Some Experiments on Reflections from Ceilings, Walls and Floors," which was presented at the Philadelphia convention of the Illuminating Engineering Society by Messrs. Lansingh and Rolph, and to which editorial reference was recently made, contains definite data which render the paper of much practical value. The tests were made in a room 25 ft. long x 12 ft. wide. It was found that to produce a given illumination on a plane 33 in. above the floor, with ceiling, walls and floor covered with dark green, and with bare lamps placed at the ceiling (a most unfavorable condition), it took 4.5 times as much electrical energy as to produce the same illumination under the most favorable conditions, with ceiling, walls and floor very light in color and lamps equipped with efficient reflectors. This corresponds very closely to results obtained by Messrs. C. A. Kelsey and L. E. Gould, in a Cornell University thesis in 1901. By using reflectors in a room in which ceiling, walls and floor are dark green (the lamps being at the ceiling in all cases in these tests), the electrical energy required to produce a given illumination is reduced about one-half. With all surroundings dark, the reflectors make the most favorable showing, since so little is obtained by reflection from the sides of the room. When, however, ceilings, walls and floor are light, the reduction in electrical energy required to produce a given illumination with reflectors on the lamps averages only 20 per cent below that required with the bare lamps. The electrical energy to produce a given illumination when ceiling, walls and floor are dark is reduced almost as much by changing the ceiling to light color as by using reflectors, namely, a little less than 50 per cent. In practice the combinations most frequently found are light ceilings with dark walls and floor, or light walls and ceiling with dark floors. Under the conditions in the paper referred to, with light ceilings and dark walls and floor, reflectors reduce the electrical energy required about 30 per cent. With ceilings and walls light, the reduction in electrical energy by the use of reflectors was about the same as with ceiling, walls and floor light, not over 20 per cent. The light-cream wrapping paper with which the sides of the room were covered for the light-color tests probably absorbed less light than any ordinary walls which would be classed as light. Furthermore, the dark-green burlap used did not represent an extreme condition, as rooms finished in dark green and black with beamed ceilings are not uncommon.

As before noted, the paper shows that with tungsten lamps in each case, 4.5 times as much electrical energy will be required to illuminate a room in one case as in another. Now, since the common carbon-filament lamp is about three times less efficient than the tungsten lamp, it would be quite possible to have on a given job a difference of 13.5 to 1 in the amount of electrical energy needed for the illumination in a certain room, a fact that the owner, the illuminating engineer and the electrical contractor should consider before planning an installation.

Lighting Float in a Parade.

At the recent Ka-Noo-No Carnival, which is held annually at Syracuse, N. Y., in connection with the New York State Fair, a float shown by the New Process Raw Hide Company, of that city, won first prize in the machinery division as the "best appointed and most symbolic." This success appears to have been due in part to the ingenious use of electricity. A view of the float is shown herewith. The globe seen at the center was supported on an upright shaft passing through the poles and



ELECTRICALLY-LIGHTED CARNIVAL FLOAT.

having a bearing at the top and bottom. This globe was about 5 ft. in diameter, and was constructed of one-ply raw hide formed in two hemispheres attached to a large gear ring at the center. Inside the globe were 30 incandescent lamps; and as this raw hide is quite translucent, the effect at night was very striking. The pinion was of raw hide carried on an upright shaft with a bearing at the bottom. This pinion was rotated by a chain drive under the truck, from one of the rear wheels, thus imparting motion to the globe as the wagon moved.

Flexible Suspension of Tungsten Lamps.

Conditions in the smaller cities and towns are often such that central-station men find it impossible to get anything like ideal installations for metallic filament lamps. It is not usually advisable for a company to recommend a customer to purchase a complete set of new fixtures in order to get a vertical socket for the installation of tungsten lamps, and it is very often utterly impossible to get a substantial anchor for drop cords and lamps where the ceilings of buildings are not constructed to withstand ordinary jars and vibrations. Neither is it advisable at times to recommend the rewiring of a building so that current for each can be turned on and off only from wall switches.

The frequently unfavorable conditions make it necessary for lighting companies to take advantage of every possible method that will aid in giving increased service life to metallic filament lamps. Many of the plans tried for getting long service from tungsten lamps have proved effective, and one of the successful methods noted is that adopted by the Portage (Wis.) Electric Light Company. This company has to meet very aggressive gas competition, and because of this was one of the first of

the smaller companies to urge its customers to adopt the tungsten lamp for lighting their homes and stores. Coincident with the first installation in Portage, the company's mechanical engineers gave some attention to the methods available for the economical installation of tungstens, and finally adopted a loosely hung flexible fixture as a standard. A delicate coil spring was devised for use on leads where drop lamps are used. This coil is made from wire in the company's shop and is not expensive. It is so constructed that the coil is readily attached at any desired point to loops made in the drop cord. It is designed to delicately support the weight of the lamp and thereby relieve the filament from unusual jars and vibrations. Every drop cord, supporting a tungsten lamp, on the company's lines is provided with one of these coiled springs.

How successful this method of suspending lamps has been is shown by the small number of lamps that have been broken in service. According to the officials of the company, not more than two or three tungstens out of several hundred installed have been broken and replaced since January, when the present method of lamp-hanging was adopted. The company is naturally very enthusiastic over the possibilities of the metallic filament lamps, when properly hung, and over the increased business made possible by their adoption.

Convention of Western Association of Electrical Inspectors.

The Western Association of Electrical Inspectors held its fourth annual convention at Chicago, Oct. 20, 21 and 22, 1908. The sessions were presided over by President E. R. Townsend, of Chicago. Mr. Townsend, in his address at the opening of the first session, remarked on the decidedly improved conditions which are making themselves apparent in wiring installations as a result of electrical inspection throughout the West. He favored a movement toward State regulation of electrical work. He pointed out that State laws have been passed regarding pure food and other matters for the protection of the public, and that it would be in order to regulate electric wiring by State laws. He considered this the more necessary because of some of the tangles of overhead construction now seen, in which wires of very high tension and those of low tension are in a confused mess on crowded streets. He said that electrical inspectors should do what they could to create public sentiment in favor of good construction and regulation of such matters. They should also, he said, use their influence with their respective State fire marshals.

One of the matters of most general interest was the report of the committee on National Electrical Code, of which Mr. J. H. Montgomery, of Detroit, was chairman. This committee reported that inasmuch as the electrical committee of the national board had appointed a sub-committee on recodification, it thought best this year not to take up suggestions for change of wording and details, such as had been considered in former reports. This is the work now being done by the committee having in charge the revision of the Code. The committee report presented instead for the discussion of the association the suggestions which had been favorably acted upon in the past by the association, but which had not been adopted by the electrical committee of the national board. The committee also recommended that the experience of members be obtained and suggestions given for definite rules or changes on the size of mains and fuse protection for alternating-current motors, the construction and installation of rheostats, and on grounding.

The association then took up for discussion and vote the following rules, recommended at last convention, but rejected by the electrical committee in charge of National Code:

A rule prohibiting all classes of wiring in show windows except approved conduit work was approved by some members, but opposed by others as being too radical. Those favoring the rule suggested that it be worded so as not to include wiring on the ceiling of the show window. In answer to an inquiry by the president as to whether approved molding work in show windows had been a source of fire in the experience of members, Mr. Fred. G. Dustin, of Minneapolis, said that he had known of several fires from this cause. One case in particular was where nuts had been piled in the lower part of a show window, moisture from which had impregnated the molding and caused the fire. Other members objected to the molding on the ground that window trimmers and carpenters were likely to drive nails in it. It was decided to refer this rule back to the committee for changes in wording, which would require approved conduit or armored cable only on the sides and floor of the show window. The proposed rule was reworded and reported back by the committee at a later session and was approved by the association.

A proposed rule requiring petticoat insulation or drained waterproof conduit on all interior work where water collects or condenses, was referred back to the committee for rewording, so as not to limit the construction to these two methods, as it was the sentiment of the meeting that other satisfactory methods might be used.

A rule requiring manufacturers to furnish as a component part of all portable fans, etc., a certain length—say, 10 ft.—of approved portable cord, was not acted upon after considerable discussion. It was the sentiment that rules could not be adopted requiring the manufacturers to do anything, and that this was a matter which should be left in the contractor's hands to deal with according to the conditions of the installation. The inspector could then accept or reject the installation, as he saw fit. A rule of this kind would probably not prevent the evil at which it is aimed, namely, the purchase by the general public of portable fans, heating and lighting appliances with unapproved and unsafe cord.

A modification of the rule which requires switchboards to be of non-combustible material, and prohibits hardwood in skeleton form, was approved and recommended to the national committee for incorporation in the Electrical Code.

An addition to Rule 14B, requiring that for wires smaller than No. 8, split knobs shall be used, and that tie wires and knobs be not approved, was approved by the association, with the provision that screws and not nails should be used with the split knobs.

A modification of Rule 14E so as not to permit deviation from this rule, which requires separation of wires from gas and other metallic pipe by some continuous non-conductor, was passed over without action. Prohibition of the use of series arc lamps for interior work was also passed over without action.

An addition to Rule 22A, requiring a 25-amp switch as a minimum sized service switch at building entrances, drew out considerable discussion. The sentiment seemed to be that if such a rule was made it should apply to all knife switches, whether service switches or not. A number of inspectors testified that the small knife switches of 15-amp capacity used both as service switches and on tablet boards were not strong enough mechanically. An increase to 25-amp capacity was urged in order to secure a switch which would be less flimsy than the 15-amp fuse. Knife switches on tablet boards were generally reported to be in bad condition after a few years' use. No action was taken.

A proposed rule to provide for two classes of construction, one for zero to 125 volts and another for 125 to 250 volts, was not acted upon.

A modification of Rule 24N, permitting the use of slow-burning insulation in conduit exposed to heat in dry places, was not acted upon. It was admitted in the discussion that such insulation was desirable in some locations and that inspectors sometimes thought wise to pass such construction in violation of the Code. The sentiment seemed to be that it was better to violate the Code intentionally than to open the door to slow-burning insulation in this way.

A proposed requirement that canopies be made movable so as to permit inspection of wires and insulating joints was not acted upon, as it was the sentiment that such action would be

going too far. As one inspector put it, the next logical thing after such a rule would be a rule requiring all wiring to be placed on the floor of a room so that the inspector could get at it easily for inspection. A rule changing the rating of lamp sockets to volts and amperes was approved.

Such of the foregoing rules as were approved or referred back for improvement in wording with approval as to their general sense are to be recommended to the national code committee.

The committee on grounding of conductors for safety, through Mr. Frank R. Daniel, of Indianapolis, chairman, gave as part of its report a lengthy quotation from a recent American Waterworks Association paper regarding electrolysis of water pipes by electric railway return currents. This part of the report favored the use of the double trolley system. Just what the subject of electrolysis from railway currents has to do with the grounding of conductors for safety was not made apparent in the report. There was a long discussion on this part of the report, in which some members endeavored unsuccessfully to have the association go on record as favoring the double trolley system as a cure for electrolysis evils. Two other sections of this report related to the subject for which the committee was appointed. One of these was on the provision of grounded guard nets under high-tension transmission lines and grounded metal work consisting of zinc strips around the base of the pole within reach of the public. Another section of the report, which was not given as a recommendation of the committee but was presented for discussion and consideration, was the plan of having one side of all electric-lighting systems grounded, with no fuses in the grounded side and all fixtures and exposed metal work also grounded. It was suggested, however, that wires be run insulated as now, in order to provide against corrosion and injury. This would mean the grounding of the neutral on three-wire systems and the omission of all fuses on the neutral wire. On two-wire systems or on three-phase systems, one wire would be grounded and fuses omitted in that wire. There would then be one continuous grounded conductor all over a system. This was not discussed.

Mr. Charles Nutter, electrical engineer of the Atchison, Topeka & Santa Fé Railroad, read a paper on "Grain Elevator Wiring." He recommended conduit construction for this work. In connection with conduits he recommended that the ends of pipes be cut square, that the end be reamed out after this cutting, and that pipes be screwed together at joints to make a tight butt fit. Where joints are to be surrounded by concrete, red or white lead should be used on the threads to prevent the concrete from leaking into and obstructing the pipe. He favored limiting the number of outlets on each branch circuit to less than 12 sockets, because lamps of over 50 watts are likely to be used in some sockets. Snap switches in grain elevators should be dust-tight. He also advised putting lamps in vapor-proof globes.

In the discussion Mr. Waldemar Michaelsen, of Omaha, criticised the practice of attempting to make a butt-joint in conduit. In fact, he said that if he saw there was evidence that the pipes had butted together before reaching a tight fit in the coupling, he would condemn the work. His position was that the bringing together of the pipe ends to make a butt-joint in itself caused a burr and that with the taper threads used on pipe a tight joint frequently could not be made if the ends of the pipe butted together. Mr. Nutter replied that he had taken down considerable butt-to-butt conduit, and had found no burrs. He explained that a special reamer had been used in putting in this work to permit the pipes to come together butt to butt.

Mr. W. H. Blood, Jr., insurance expert of the National Electric Light Association, addressed the convention on the subject of "Electrical Inspection from the Viewpoint of the Central Station."

The committee on architects' specifications reported through its chairman, Mr. F. H. Moore, of Indianapolis, Ind. No specifications were submitted to the association. Reference was made to a book about to appear by a member of the association, Mr. J. H. Montgomery, of Detroit, and also to a copyrighted set of specifications written by Mr. D. A. Britten, of Detroit. The committee expressed itself as being not very hopeful of draughting specifications which would be accepted as a standard by all architects. Still, it is hopeful of getting its specifications into the hands of many architects, engineers and builders. It also urged that the inspectors keep in close touch, by means of personal calls, on architects, engineers and builders, and by bulletins sent out from time to time, explaining various rules of the company and calling attention to the merits of fittings.

The report of the committee on public safety, of which Mr. W. J. Canada, of Denver, was chairman, presented some figures on accidents caused by electric current, and urged that more accurate records be kept and that means be employed to keep the public better informed as to methods of avoiding accidents of this kind. An abstract of Mr. Canada's report will appear in a later issue.

The last day of the convention the meeting was held at the Underwriters' Laboratories, on Ohio Street. Mr. W. H. Merrill, Jr., manager of the Underwriters' Laboratories, gave a brief address on the work of the laboratories and was followed by Mr. Dana Pierce, electrical engineer of the Laboratories. A number of tests of fittings were then carried on under his direction before the meeting to show how some fittings act under a short-circuit. The members had an opportunity to see the way tests of fittings are carried on at the Laboratories. Mr. Merrill, in his address, pointed out the advantage of having one central laboratory as an authority rather than a number of laboratories scattered in different parts of the country and divided authority. The recent action of the National Board of Fire Underwriters had made possible a considerable addition to the present building. Stock companies are now contributing $25,000 a year to the maintenance of the Laboratories, and other companies also contribute. He called special attention to the importance of relying on the laboratory test of new devices as against taking the judgment of any man, no matter how competent, without laboratory test. He said that inspectors might feel, by virtue of their long experience in the observation of the behavior of electrical fittings, that they were competent to judge of the merits of devices. He gave as an example a case in which he himself, in the light of his extended experience, had said offhand that a certain switch submitted was excellent and no doubt would pass. When put on test, it broke down after only 150 operations from causes which could not well have been foreseen by any casual inspector. After that experience he did not consider that any man's judgment could replace laboratory tests of fittings. In fact, he said there was a standing offer to pay any man double the salary he might be getting now elsewhere to come and pass judgment on fittings without putting them through test, provided his judgments were as reliable as the tests. If a man with such an *X*-ray discernment could be found, it would save the Laboratories a lot of time and work testing. A question was asked Mr. Merrill as to the recent discontinuance of underwriters' connection with the wire inspection bureau. Mr. Merrill explained that the bureau, as it was being conducted, consisted of men partly in the employ of the association of insulated wire manufacturers and partly in the employ of the underwriters. As this was an inconsistent condition of affairs, and as the underwriters did not care to get mixed up in wire manufacturers' association matters, it was decided to discontinue the underwriters' participation in wire inspection. The present wire inspection is, therefore, an inspection for manufacturers by manufacturers and not an inspection by those interested in the fire hazard.

Mr. Dana Pierce, electrical engineer of the Laboratories, urged that inspectors and all others interested in electrical work let the Laboratories know when approved devices showed defects in the field. The Laboratories must necessarily pass on appliances when they are new and untried in practice. It is important that the Laboratories know what results are being obtained with such appliances in the field.

The evening of Oct. 22 the association was entertained by the Illinois Electrical Contractors' Association at a dinner at the Bismarck.

the Bismarck.

The report of Secretary and Treasurer Wm. S. Boyd, made at the opening of the convention, showed a membership of 183—a gain of 23 in the past year. The membership comprises both underwriters' electrical inspectors and municipal inspectors.

The following officers were elected for the coming year: President, Mr. Geo. W. Bayle, chief city inspector, Chicago; first vice-president, Mr. Frank R. Daniel, Indianapolis; second vice-president, Mr. Frederick E. Hough, of Duluth; secretary and treasurer, Mr. Wm. S. Boyd, 125 Monroe Street, Chicago.

Executive committee, Messrs. Fred. G. Dustin, Minneapolis; James H. Fenton, St. Louis; Waldemar Michaelson, Omaha; F. D. Varnam, St. Paul; E. R. Townsend, Chicago; J. H. Montgomery, Detroit.

Letter to the Editors.

Hydro-Electric Station Operating Without Attendant.

To the Editors of Electrical World:

Sirs:—The omission of the word "by" in the last column of my article entitled "Hydro-Electric Station Operating Without Attendant" in your first issue for September has resulted in interchanging a cause for an effect. The expression " . . . by action of the belt caused racing of the waterwheels" should have been " . . . by action of the belt caused by racing of the waterwheels."

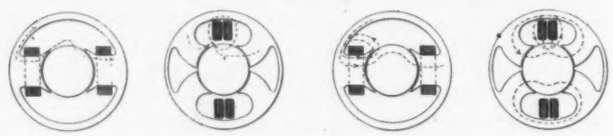
Springfield, Vt. M. A. Hicks.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Generator Construction.—An illustrated article on the design of a new direct-current generator of English make, known as the "Zone" generator, and designed so as to reduce the self-induction of the armature coils undergoing commutation, and also to prevent injurious distortion of the field. The field poles are usually cast solid with the yoke-ring, so as to save machining, laminated poles only being used in certain special cases. Figs. 1 and 2 illustrate the distortion of the main field due to armature m.m.f. Figs. 3 and 4 illustrate the distribution of the leakage flux. Figs. 1 and 3 represent the ordinary type of construction, Figs. 2 and 4 the corresponding construction of the "Zone" machine. As will be seen in Fig. 2, the poles are bifurcated. The bifurcation has the effect of greatly throttling the cross flux due to the armature ampere-turns, and



FIGS. 1, 2, 3 AND 4.—GENERATOR CONSTRUCTION.

incidentally of shortening the path of the main flux, thus reducing the number of ampere-turns required for excitation. The field coils are wound so that the portion between the poles lies close to and parallel to the armature coils undergoing commutation. By this arrangement it is said that the field coil acts in a manner similar to the closed secondary of a transformer, reducing or choking the current in the armature coil during the time it is short-circuited by the brush, or, in other words, reducing the self-induction and reactance voltage. It has been found possible in these machines to commutate successfully with (calculated) reactance voltages three to four times as high as those considered permissible in the ordinary type of machine. A further advantage claimed is that injurious distortion of the field is prevented owing to the main field or magnetomotive force acting directly in the neutral zone instead of on each side. The flux distortion in the ordinary type of machine is shown in Fig. 1, and in the "Zone" machine in Fig. 2. It will be seen that in the latter case the incasion, as it were, of the distorted field is repelled by the main field and the neutral zone kept "neutral." Another advantage is claimed from the fact that in the ordinary machine magnetic leakage from the armature is disadvantageous and detracts from the flux efficacy, as shown in Fig. 3, whereas in the "Zone" system the space between the pole and the coil is practically added to the polar surface, as can be seen from Fig. 4, thus increasing the flux efficacy. In some sizes the increase in efficacy amounts to about 10 per cent, the wasteful magnetic leakage being practically nil. It will be seen that there is a certain flux in the teeth surrounding the short-circuited armature coils, the field coil acting in this respect as an interpole, without the disadvantages associated with an iron interpole; namely, increased magnetic leakage and reactance voltage. Owing to the greatly increased stability of field and the prevention of distortion, these machines are specially adapted for high speeds, and where it is necessary to run with weak fields, as in the case of variable-speed motors. It is also unnecessary to increase the number of poles in order to reduce the armature ampere-turns per pole.—Lond. *Elec. Eng'ing,* Oct. 15.

Alternator Armature Winding.—A note on a recent British patent (21073) of Siemens Bros. and Kloss. In a spiral winding for alternator armatures the necessity for open slots is avoided, and the use of semi-closed slots is rendered possible by arranging the former-wound coils in such a way that each coil-limb fills only half a slot, and that the pitch of two adjacent coils belonging to the same group or pole differs by the tooth-pitch only.—Lond. *Elec. Eng'ing,* Oct. 15.

Lamps and Lighting.

Arc Lamps.—A continuation of the long illustrated serial giving descriptions, mainly taken from patent specifications, of recent improvements in arc lamps. The present installment deals with arc lamps with carbon electrodes placed side by side in inclined downward position.—*Zeit. f. Beleucht.,* Oct. 10.

Generation, Transmission and Distribution.

Hydro-Electric Stations of Switzerland.—F. Hoppe.—The first part of a very full statistical article on the hydro-electric stations of Switzerland. It is valuable in giving mean values based on the statistics of the Swiss Electrical Society. In Switzerland 50.8 per cent of all electric stations use merely water power, while 36.2 per cent more use both water power and steam or gas as reserve. Thirty-seven and five-tenths per cent of the total rating of all works is produced in purely hydraulic power stations, while 59.8 per cent more is produced in power plants using both water power and steam or gas. The total number of plants in Switzerland which transmit or distribute electrical energy (excluding traction plants) is 539. Of these 240 generate all their energy themselves; 50 plants buy energy from other works, if their own generating equipment is insufficient; and 249 plants buy their whole energy in bulk from others. In the generating stations direct current is used in 85 cases, single-phase current in 87, two-phase currents in 11, and three-phase currents in 150 cases. For lighting, the e.m.f. is from 100 to 120 volts in 52 per cent of all works, 150 volts in 17 per cent and from 200 to 240 volts in 31 per cent. Figures are also given on the voltage of transmission. The frequency used in alternating-current stations is 50 in 67 per cent of all plants

and 40 in 15 per cent, other special frequencies being used in the balance of the plants. The total connections at night time are 66,000 kw for motors, 67,500 for lamps and 11,000 for heaters, while 16,000 kw more are connections of motors, which are permitted to be used only during the day. Figures are also given on the first costs as follows:

	Cost of hydraulic and steam, etc., plant per kw.	Cost of electric plant per kw.	Total cost per kw.
171 plants, generation, transmission and distribution	$140	$130	$270
74 plants buying electrical energy in bulk for distribution	—	115	115

It is interesting to compare these figures with those of Germany. According to the statistical tables of *Elek. Zeit.*, relating to the 844 plants, the mean value of the total cost of installation per kilowatt is $320, while the mean figure of the statistics of the Association of German Electricity Works (relating to 123 stations) is $375. Figures are also given for the cost per kilowatt in stations of different sizes. Another table shows that the first cost per kilowatt is smaller in pure water-power plants than in combined hydraulic and steam plants or in gas plants. Finally, figures are given concerning the variation of water supply. The paper is to be concluded.—*Elek. Anz.*, Oct. 18.

Austrian Water-Power Plant.—H. TENZER.—An illustrated description of the water-power installations at the Kerka River in Dalmatia. The first hydro-electric station was erected at the Kerka River in 1894. It had a rating of 300 hp and generated single-phase current at 3000 volts, the frequency being 42, the energy being used for motors and for lamps. In 1898 a second 300-hp plant was erected for supplying energy to an experimental calcium carbide plant. Two larger water-power plants were later erected for greater calcium carbide plants. One,

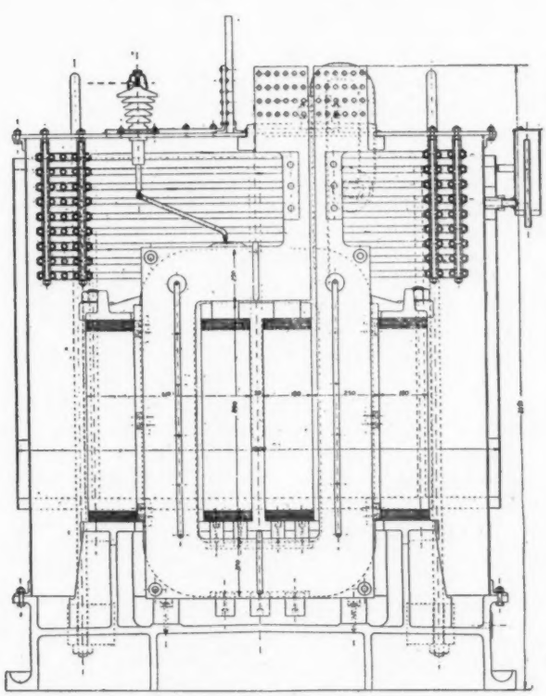


FIG. 5.—DETAILS OF DESIGN OF TRANSFORMER.

having a rating of 5000 hp, started operation in 1903. It contains two turbines, each coupled to a two-phase, 3000-kw generator. The energy is transmitted at 15,000 volts to the carbide plant, where eight single-phase transformers reduce the voltage to 48. The transformers are adjacent to the eight carbide furnaces, so that the connections between transformers and furnaces, which have to carry 15,000 amp, are short. The last plant has a rating of 24,000 hp, with four 6000-hp generating sets. Three-phase currents at a frequency of 42 periods are generated at 30,000 volts. Twelve single-phase, water-cooled, 1500-kw oil transformers reduce the voltage from 26,000 to 48. The energy is supplied to the carbide furnaces at 48 volts, each transformer supplying two furnaces. Each transformer can be connected to any phase so as always to have the three-phase system balance. For cooling the transformer sea water is used which circulates in copper pipes placed in the transformer oil. In order to facilitate the regulation of two furnaces receiving energy from one transformer, instruments are provided which indicate the difference of the load of the two furnaces in per cents. Details of the design of the 26,000-to-48-volt transformers are given in Fig. 5.—*Elek. u. Masch.* (Vienna), Oct. 4 and 11.

Flywheel Load Equalizers.—While flywheel load equalizers have been used extensively before on a large scale, especially in connection with mine hoisting and in steel rolling mills, an example of a flywheel energy storage system was shown at the Manchester Electrical Exhibition by a British company for use in connection with tramways, small railways, docks, ship yards and every form of intermittent industrial power load. It is fitted with a special armored-plate flywheel 8 ft. 9 in. in diameter by 4 in. thick. The rating of the set is 150 amp at 500 volts for 2 minutes, 200 amp for 1.5 minutes and 300 amp for 0.75 minute. The speed varies between 950 and 670 r.p.m.; the weight of the flywheel is 5.5 tons. Forced lubrication is supplied to the set, a small pump being provided for the oil circulation. The machine driving the flywheel is fitted with interpoles and has open fan ventilation. The function of the flywheel equalizer set is to "even up" the load on the generating plant by supplying energy to the line when the speed of the set is a maximum and receiving energy from it when it is a minimum. Between the extreme limits of speed, therefore, the machine acts successively as a generator and as a motor. The machine has three field windings: (1) A shunt-field winding for limiting the maximum possible speed; (2) a small series field winding connected in the armature circuit to compensate for armature voltage loss, and (3) a main series field winding carrying a varying fraction of the current supplied by the main plant. The degree of diversion of current into the latter field winding is regulated by an automatic switch-gear, which cuts in or out more or less resistance across the field circuit. The automatic gear for this purpose consists of two powerful electro-magnets operating alternately on each side of a toothed wheel. The circuits of these magnets are controlled by a small governor, which energizes the one or the other according to the current in the governor solenoid. This solenoid carries the current of the plant which it is desired to regulate, and any small change will set the diverter switch in motion so that an immediate response to any changes of load is followed by the operation of the automatic gear. The gear produces the changes of field strength required for the wide range of speed, which is, of course, a necessary feature of commercial flywheel-storage systems. A change in the external demand on the system may be experienced large enough to alter the equalizer's action from heavy motoring to heavy generating without any movement of the auto gear, which only comes into operation when the generating action of the equalizer has reduced its speed, rendering desirable a change in the degree of diversion of the main series-field current. A feature of the set is that the large field coil carries the current of the main plant and thus cannot change without immediately altering the field strength of the equalizer, practically forcing it to respond. —Lond. *Elec.*, Oct. 16.

Electric Driving of Rolling Mills.—C. KOETTGEN AND C. A. ABLETT.—An Iron and Steel Institute paper in which the authors give the following figures for the energy required for rolling different sections, using Bessemer steel, and taken from the results obtained from over 150 rolling mills. The high values for the kw-hours per ton rolled for the channels and tees under reference Nos. 11-14, may be attributed chiefly to the cooling of the section toward the last passes, the temperature reducing to about 850 deg. This cooling is due to the large surface which the section presents in proportion to its weight.

The results for the sheets under reference Nos. 18, 19 and 20 also show large values for the kw-hours per ton. This is due to the large number of passes required, and to the rapid cooling of the sheets owing to the large surface which they present. The temperature of the metal before the first pass ranged from 1183 deg. to 1250 deg., while at the last pass it had come down to 800 deg.

No.	Type of section.	Energy required, kw-hours, per ton.	Final length, ft.	Weight of billets, lb.	Dimen. of billets, in.
1	Flanged mine rail, 28 lb. per yd...	37.5	92-97	860-910	5.1 by 5.7
2	Flanged mine rails, 24 lb. per yd..	41.8	68-94	550-760	"
3	Flanged mine rails, 20 lb. per yd..	44.5	130	660-875	"
4	Flanged mine rails, 18 lb. per yd..	47.5	90-135	550-815	"
5	Flanged mine rails, 12 lb. per yd..	48.6	87-135	353-547	4.3 by 4.7
6	Flanged mine rails, 8 lb. per yd...	54	113-139	330-375	"
7	Round bars, 1.2 in. diam.....	38.3	89	327	5.1 by 5.1
8	Round bars, 1.7 in. diam.....	40.3	43.5	287	"
9	Square bars, 0.8 in. square.....	42	82	165	"
10	Square bars, 1.4 in. square.....	28.8	51	335	"
11	Channels, 1.57 in. x 0.79 in. x 0.2 in.	63.50	98	187	"
12	Channels, 1.18 in. x 0.59 in. x 0.16 in.	111	105	154	"
13	Tees, 1.2 in. x 0.16 in.....	136	82	110	"
14	Tees, 1.38 in. x 1.8 in.....	68.2	88.5-92	155	"
15	Flats, 2.35 in. x 0.4 in.....	33.3	98	330	"
16	Flats, 1.95 in. x 0.4 in.....	41.5	106	294	"
17	Flats, 1.5 in. x 0.32 in.....	52	105	176	"
18	Sheets, 42 x 95 x 0.09 in.....	84	—	388	7.9 square
19	Sheets, 51 x 147 x 0.22 in.....	95	—	450	33.5 by 15 by 4.7
20	Sheets, 48 x 88 x 0.1 in.....	80.0	—	415	6.7 square

The authors then discuss at some length the question of overloading the motor. They show that it is very necessary so to dimension the motor that it will be capable of dealing with momentary overloads without danger. It is almost invariably found that when a steam engine driving a rolling mill is replaced by an electric motor a greater output is obtained from the mill. The rail mill, from which results Nos. 1 to 6 were taken, was installed for an output of 100 tons per day, but the results show that this figure has been considerably exceeded, and 150 tons per day have frequently been obtained. This is due to the fact that the speed of the electrically-driven mill remains very nearly constant, whatever work it is doing, and in this case the speed of the mill was much increased when the electric drive was installed.—Lond. *Elec.*, Oct. 16.

Refuse Destruction.—B. Heine.—A paper read before the Dresden Electrical Society pointing out the importance of refuse destruction for generation of electrical energy. While refuse destruction is necessary primarily for hygienic reasons, the possibility of using refuse destructors in combination with power stations should not be overlooked. From results obtained in a number of German cities it is estimated that 1 kg of refuse yields from 0.6 kg to 1 kg of steam, a pressure of from 8 to 12 atmospheres. The author gives the following figures of Dettmar on the available electrical energy from refuse destructors for continuous operation during 24 hours per day in cities of different sizes:

Inhabitants.	Kw.	Kw-hours.
250,000	286	2,500,000
100,000	104	911,000
50,000	47	411,000
20,000	17	149,000

It is recommended that the state or large cities should erect an experimental station to investigate the different systems of refuse destructors.—*Elek. Zeit.*, Oct. 1.

Tests of Turbo-Alternator Set.—An illustrated article on small steam turbines made by a British company for sets rated at from 200 kw to 700 kw, the speeds between these limits of output being in all cases 3000 r.p.m. for frequencies of 25 and 50, and 3600 r.p.m. for a frequency of 40. Tests were made with 700-kw sets. The turbines are arranged for working at a boiler pressure of 150 lb. and for dealing with a super-temperature up to 250 deg. Fahr., when exhausting into a vacuum of approximately 28 in. The alternators are of the three-phase type, 50 cycles per second, 380 volts, having direct coupled on their shaft an exciter, and run at a speed of 3000 r.p.m. A consumption of 15.5 lb. of steam per kw-hour was obtained at a 900-kw load, and 16 lb. per kw-hour at 700 kw, the vacuum being 28.2 in. (bar. 30 in.), and the super-temperature 240 deg. Fahr.—Lond. *Elec. Rev.*, Oct. 16.

Electric Equipment of Rolling Mills.—An illustrated description of the first heavy reversing rolling mill in England to be electrically driven, which is one in the works of Dorman, Long & Company. at Middlesborough. The rolls are directly coupled to a 1200-hp continuous-current motor capable of working up to 3600 hp, supplied with energy through an Ilgner flywheel set driven by a 950-hp, three-phase motor.—Lond. *Elec. Eng'ing*, Oct. 15.

Hydro-Electric Plant.—An illustrated description of the hydro-electric plant of the Inland Empire system. This plant is located at Nine-Mile bridge on the Spokane River, 13 miles from Spokane. The rating of the station is from 15,000 hp to 18,000 hp. There are four 5000-hp generating stations. The generators are of the revolving-field engine type, designed for 2200 volts, three-phase, 60 cycles.—*Elec. Railway Jour.*, Oct. 10.

Traction.

Accumulator Traction.—Two articles referring to the use of accumulators on railroad cars and on omnibuses. The first article describes a type of accumulator car which is being adopted to a considerable extent on the Prussian State Railways, and which is stated to give satisfactory results. With a battery of 180 cells, rated at 200 amp-hours, speeds of from 20 to 30 miles per hour are obtained, and at a speed of 24 miles per hour these cars can cover a distance of 36 miles on one charge. The life of the positive plates is said to be 62,000 car-miles and of the negative plates 37,000 car-miles. The question of weight is second in importance only to that of the life of the plates, and in the case of these cars, the accumulators are stated to yield 6.85 watt-hours per kilogram; that is, 3.1 watt-hours per pound of cell complete. (Editorially it is remarked that this figure does not compare favorably with that for the Tudor batteries used on a London electrical omnibus, for about 12 watt-hours per pound are obtained from those accumulators). However, under railway conditions weight is not so important, and this may account for the long life that is expected. In the second article the Edison iron and nickel storage battery, as made in Germany for traction purposes, is described. An output of about 11 watt-hours per pound of complete cell is claimed.—Lond. *Elec.*, Oct. 16.

Berlin.—An illustrated article on a recently completed extension of the Berlin elevated and subway. The extension comprises a 2.3-km tunnel in the center of the city. It is almost throughout double track. The cost of the building and equipping of this extension has been high; namely, $2,500,000 per kilometer. The erection has required two years. The trains will follow each other at intervals of about three minutes.—*Elek. Zeit.*, Oct. 15.

Motor Trucks.—P. Dawson.—A continuation of his long illustrated serial on electric traction on railways. In the present installment the author discusses the best methods of suspending the motors from the trucks.—Lond. *Elec.*, Oct. 16.

Automatic Signals.—An illustrated description of the Gardiner system of cab signaling which has been tried on the Indian state railways.—Lond. *Elec.*, Oct. 16.

Electric Railway Convention.—A very complete account of the proceedings of the five street railway associates which met at Atlantic City, with the papers presented, is contained in the daily edition of the *Electric Railway Journal*, Oct. 13, 14, 15 and 16.

Installations, Systems and Appliances.

Current Limit Switch.—An illustrated description of a switch made by a German company for use in installations in which a flat rate is charged under the condition that not more than a certain amount of current is used at any time. The switch indicates automatically whenever the current rises beyond the permissible maximum limit. The arrangement of the instrument, which is based on the hot-wire principle, is shown in Fig. 6; *a* is a glass tube partly filled with mercury which in the position shown in the illustration connects the two poles *i* and *k* so that the circuit is closed; *f* is the hot wire, and *g* is a spring which attracts *b* when the hot wire *f* extends its length. When the current rises above a certain amount, the glass tube *a* assumes such a position that the column of mercury is broken and the mercury flows to the right in the tube *a*. The hot

wire then contracts again, *b* and *a* are brought back to the position shown in the illustration, and the circuit is again closed. This will go on until the consumer has arranged his

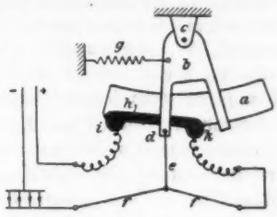


FIG. 6.—CURRENT LIMIT SWITCH.

lamps, etc., so that the current is below the permitted maximum.—*Elek. Zeit.*, Oct. 1.

Automatic Leakage Switch.—An illustrated description of a protective device shown at the recent Manchester electrical exhibition. It is indicated in Fig. 7 and is used to deal with a small earth leak on one wire; it at once cuts off both leads

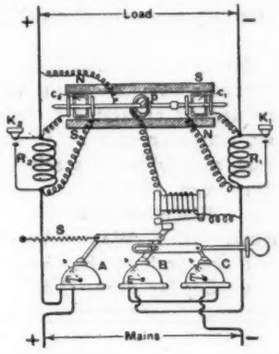


FIG. 7.—CONNECTIONS OF AUTOMATIC LEAKAGE SWITCH.

before the leak can reach a dangerous amount, and, as long as the leak exists, the protective circuit cannot be closed again. In the diagram, which shows the working of this switch, R_1 and R_2 are two resistors in shunt to two moving coils C_1 and C_2. These are mechanically connected together on one spindle, which is, however, electrically broken in the middle by ebonite. As long as the insulation to earth is perfect on both leads, all the electricity through the resistor R_2 will go through the load and return through the resistor R_1; and there will be no movement of the coils C_1 and C_2, as the currents will have equal and opposite effects; but should one lead leak, the coils will no longer balance, and will deflect, causing the tongue *p* to make a contact with one side of the fork and complete the circuit through the relay magnet. This action pulls up the trigger and frees the arm of the switch *B*. The spring *S* at once breaks this switch and also the switch *A*, which is joined to it by an insulated arm. The switches can only be closed again by pulling on the handle outside the case, which is attached to the switch *C*. This latter is connected to *B* by an insulated slotted link, so that before it can begin to pull on *B* it must be moved sufficiently to break its own contact. The switches *B* and *A* being pulled to position, are then kept there by the trigger. The handle is then pushed back, and *C* closed, but, if the leak is still on, the trigger is instantly released and the circuit broken again. The keys K_1, K_2, are for testing the instrument.—Manchester Electrical Exhibition Supplement to Lond. *Elec. Eng'ing*, Oct. 15.

Police Regulations.—After the Prussian Department of Commerce had worked out a set of police regulations on the installation, operation and supervision of electric equipments, the Association of German Electrical Engineers called a meeting of representatives of numerous national engineering societies and delegates from larger cities. Fifty-five delegates were present and a committee of 10 was appointed to work out, as a counter proposition, a new set of police regulations. This has been submitted to the Prussian Department of Commerce and is now published. It is recommended to wait a few years before any such regulations should be put into force. It is further recommended that the police regulations should extend only to installations in which a public interest is involved. A further extension of police regulations to the supervision of private electrical installations is thought to be unnecessary and highly undesirable, since industrial installations are already subject to the supervision of trade inspectors and of the officials of the departments of buildings, and of the fire department.—*Elek. Zeit.*, Oct. 15.

Drying Out Electrical Machinery.—D. VALENTINE.—An article on the experience of the Dallas Electric Light & Power Company with drying out electrical machinery after being entirely submerged in muddy water for several days.—*Stone & Webster Pub. Serv. Jour.*, October.

Wires, Wiring and Conduits.

Aluminum and Copper.—A note stating that after the purpose of the international aluminum syndicate has been crossed by outsiders erecting aluminum plants in Europe, the syndicate was abolished on Oct. 1. This action has resulted in a further reduction of the price of aluminum in Europe. The difference in price between aluminum and copper in London is now slight. The London price on Oct. 9 of electrolytic copper was then 64.5 to 65 pound sterling, the price of aluminum 70 to 75 pound sterling per ton. (This is equivalent to an aluminum price of 16 cents per pound.)—*Electrochem. and Met. Ind.*, November.

Electrophysics and Magnetism.

Hertzian Waves.—L. ZEHNDER.—An illustrated paper read before the Berlin Electrical Society giving a review of experiments with Hertzian waves and their significance for theory and industry.—*Elek. Zeit.*, Oct. 15.

Changes in Spectra.—C. SHEARD.—An account of an experimental investigation of capacity and current density effects in the argon and hydrogen spectra. The chief conclusion is that the variation in the spectrum of a gas due to inserting capacity in multiple with the spectrum tube may be produced by an increase in current density.—*Phys. Rev.*, October.

Electrochemistry and Batteries.

Storage Battery Exhibit.—An illustrated note on the storage battery exhibit of the Hart Accumulator Company, at the Manchester Electrical Exhibition. A complete battery of 30 11-plate cells for lighting purposes, with a rating of 300 amp-hours, was shown. The cells were fitted with non-corrosive terminals, and provided with a sheet separator, which consists

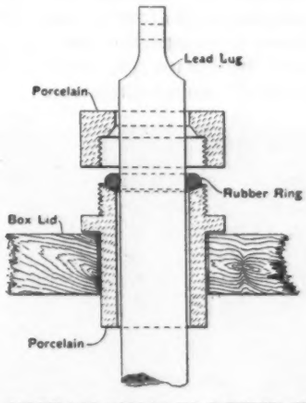


FIG. 8.—PORCELAIN COLLAR TO PREVENT CREEPING.

of a cellulose fabric, such as ordinary muslin coated with pulp cellulose. These sheets, which are quite porous, are nitrated to a sufficient degree to be unaffected by the acid electrolyte. The plates are spaced widely apart with nine-sixteenths diameter glass separators, and the separating sheets are placed between the glass separators and the plates. Short-circuiting through dislodgment of the active material is effectually prevented by the use of these sheets, without, it is said, any increase in the internal resistance. Among the various other

types of cells shown are some with lead-lined wooden boxes. An interesting feature of these cells is the provision of a porcelain collar to each terminal to prevent creeping. This collar, which is illustrated in Fig. 8, consists of two pieces between which is squeezed a rubber ring. The lower piece has a flange which rests upon the box lid, and when the other piece is screwed on, the rubber ring is pressed against the leaden lug. This arrangement not only effectually prevents creeping, but also fixes the collar firmly to the lug. Those cells which are intended for private yacht lighting have an unusually large amount of space above the plates, and are also supplied with wooden floats to prevent the acid from being spilled. The lids are also provided with rubber rims.—Manchester Electrical Exhibition Supplement to Lond. *Elec. Eng'ing*, Oct. 15.

Electric Steel Plant.—An illustrated description of an electric-furnace plant at the steel works of Oehler & Company, at Aarau, Switzerland. Use is made of the Girod furnace in which one of the electrodes is placed in the bottom of the hearth. To finish a charge of 1500 kg a current of 5500 amp at an average of about 55 volts is required for about five hours. Energy is bought from a central station at a special rate of from 0.6 to 0.8 cents per kw-hour for smelting.—*Electrochem. and Met. Ind.*, November.

Three-Phase Induction Furnace.—B. Neumann.—An illustrated description of the Roechling-Rodenhauser induction furnace for operation on three-phase circuits. Compared with the older types of induction furnaces, the new three-phase furnace has the advantage that a satisfactory power factor can be obtained with large furnaces operated by alternating current of normal frequencies. There is also an editorial discussion of the evolution of the induction furnace design, with special reference to the improvement of the power factor.—*Electrochem. and Met. Ind.*, November.

Electric Steel Furnaces in Europe.—A statistical table of the different steel plants in Europe using electric furnaces for steel refining. There are 16 Héroult furnaces, 11 Stassano, 11 Girod, 12 Kjellin and 10 Roechling-Rodenhauser, and 11 of various other designs.—*Electrochem. and Met. Ind.*, November.

Hydration of Ions.—E. W. Washburn.—An account of an experimental investigation the object of which was to determine hydration of ions by transference experiments in the presence of a non-electrolyte. One of the most interesting results seems to be that the true transference number for potassium chloride is independent of the concentration up to 1.2 molar at least.—(Mass. Inst.) *Tech. Quarterly*, September.

Units, Measurements and Instruments.

Speed Meters.—P. Bautze.—An article giving a resumé of the different systems for measuring the speed on railroads or automobiles. Types of measuring and recording instruments for installation both along the road and on the cars are described. The article is valuable for many references to original articles. Attention is called to the fact that many designers of recording speed-meters use mechanical rather than electrical means, and that there does not yet exist a reliable recording speed-meter operating on a purely electrical principle.—*Elek. Zeit.*, October.

Testing Table Cabinet.—C. A. Smith.—An illustrated description of a simple and convenient testing table cabinet, to be used in cases where testing apparatus is required to be kept under lock and key, and connected up in readiness to make occasional rapid tests, and where a special test room is not necessary.—Lond. *Elec. Rev.*, Oct. 16.

Miscellaneous.

Bureau of Standards.—H. T. Wade.—An illustrated account of the equipment and the work of the United States National Bureau of Standards.—*Eng'ing Mag.*, October.

NEW APPARATUS AND APPLIANCES

Induction Motors in a Piano Factory.

In the plant of the Krell Auto Grand Piano Company, Connersville, Ind., is to be found an interesting example of the application of alternating-current induction motors to wood-working machinery.

Three-phase electrical energy is furnished by the local light, heat and power company at 60 cycles and 220 volts. The motors, 20 in number, ranging in rating from 1 hp to 30 hp, inclusive, are of the squirrel-cage type, with the exception of two elevator motors which are of the wound-rotor type.

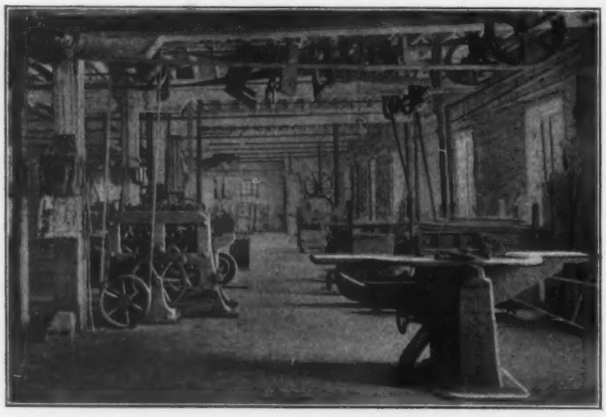


FIG. 1.—GENERAL VIEW OF MILL ROOM.

The smaller motors, 1 hp to 5 hp, inclusive, are equipped with special double-throw starting switches, the larger sizes with Triumph air-cooled transformer starters, with the exception of the two elevator motors, which are furnished with Reliance elevator controllers.

In making the installation the existing conditions had to be taken into consideration, for the factory building had been previously used for the manufacture of furniture and considerable shafting and some wood-working tools were left in place.

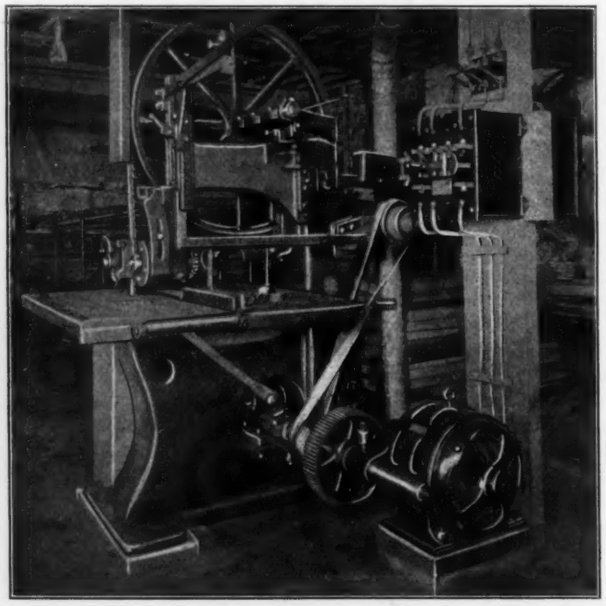


FIG. 2.—MOTOR-DRIVEN BAND SAW.

It being the desire of the company to begin operations just as quickly as possible, it was decided to group the new machinery as far as could be with the old. Of course, there were some cases where it was advisable to move some of the old machines and group them with the new ones which were to be in operation at the same time, and this was done so that the efficiency of the installation is above that of the average of motor-driven plants.

The heavier machines and those which are used intermittently are driven by individual motors, as are also a few of the lighter machines which are so located as to make it impractical to extend a line of shafting to include them. The general scheme of the drives is as follows:

Driven machine.	Method of connection.	Rating of motor in hp.	Speed in r.p.m.
Swing saw	belted	3	1,800
Band rip saw, 42-in	direct	10	1,200
Six-foot glue jointer	coupled, back geared	5	1,800
Roughing planer, 30-in	belted	12.5	1,200
Facer, 24-in	belted	3	1,800
Sander, 36-in	coupled, back geared	10	1,200
Back shaping machine	coupled	15	1,200
Planer, 24-in	belted	10	1,200
Arm boring machine	belted	3	1,800
Flexible boring machine	belted	1	1,800
Rubbing machine	belted	1	1,800
Veneer knife, 60-in	belted	3	1,800
Double exhaust fan	direct	30	1,200
Two elevators	belted	7.5	1,200

Rating of motor in hp.	Speed in r.p.m.	Group drives, driven machines.
15	1,200	Band saw, 32-in. Tenoning machine Jig saw Two boring machines
3	1,200	Knife grinder Saw gummer
15	1,200	Sticker, 12-in. Sticker, 8-in.
3	1,200	Cabinet saw Drill press
25	1,200	Double cut-off saw Shaper Jointer or wood worker Disk sander Equalizing saw Emery stand Edging saw Knife grinder Carving machine Cabinet saw

There is probably no class of machinery in which the power required to drive a given tool varies so much as in wood-working machinery, and it was on this basis that the sizes of the various motors for the individual drives were selected. For the larger group drives it was carefully figured what machines would be in use simultaneously so that the motors would

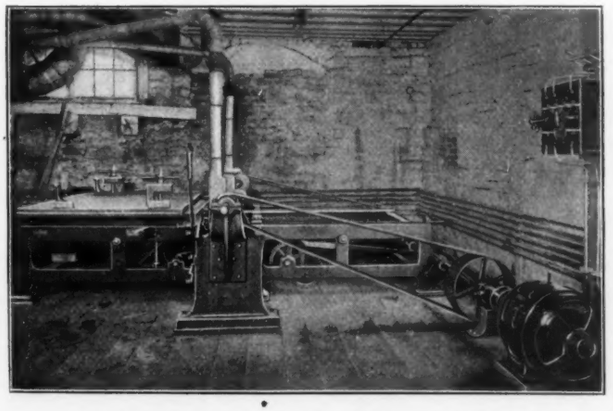


FIG. 3.—MOTOR-DRIVEN BACK SHAPING MACHINE.

operate as nearly as possible at their rated loads and therefore give the highest efficiency and power factor. It should be stated here that in one or two cases the motors installed for the smaller groups are somewhat larger than required for the present connected load, and this was done intentionally to provide for the addition of small tools in the future.

The accompanying illustrations are views taken from various points in the factory. It is noteworthy that all of the line-shaft motors and some of the individual-drive motors are inverted and suspended from above, being belted either across to the line shafts or coupled directly to shafts which are belted through the floor above the tools. In this way those two valuable assets, floor-area and head-room, so much sought after in every factory installation, are utilized to the very best advantage; they cannot be secured when the motors are mounted on the floor and belted to the shafting overhead.

Fig. 1 is a general view of the mill room. A 25-hp motor suspended from the ceiling is belted through shafts and countershafts to a jointer or wood worker, equalizing saw, double cut-off saw, disk sander, carving machine, cabinet saw, shaper and emery-stand, edging saw and knife grinder. This is one of the

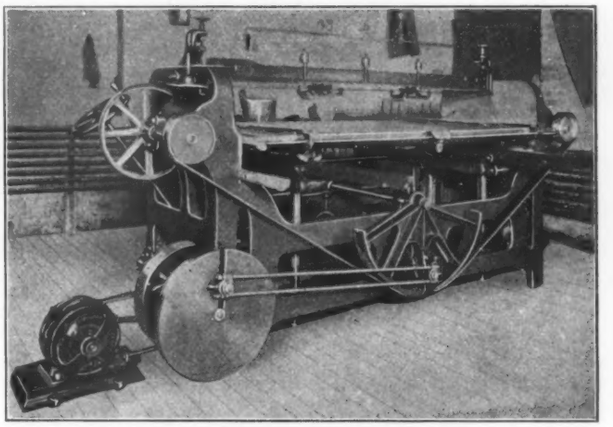


FIG. 4.—MOTOR-DRIVEN RUBBING MACHINE.

cases where the motor would be too small if all of the tools were operated simultaneously. However, they are never run in this way, and when a majority of them are in use it is only for a short interval, and the motor is perfectly capable of withstanding a heavy overload for this period.

Fig. 2 shows an interesting application of a motor to a 42-in. band rip saw. The motor is a 10-hp machine fitted with a back-geared bracket on the pulley end. The back-geared bracket for the opposite end of the motor and the back-geared shaft usually furnished with this type of motor are not supplied in this case. The floor hanger and pulleys have been removed from the saw countershaft, the gear wheel mounted on the counter, meshed into the rawhide pinion on the motor shaft, and the shaft is carried on the bearing of the motor bracket.

Fig. 3 shows a 15-hp motor connected through a flexible coupling directly to the countershaft of a back-shaping machine. The chief virtue of this "drive" is that one belt is entirely eliminated. The motor is entirely out of the way; this is quite an item in the section of the factory where long lengths of lumber are being continually moved.

Fig. 4 shows a 1-hp motor mounted on the floor and belted to a rubbing machine. This machine is one of the great labor savers in a piano factory, doing the work of three men in about one-half the time. Two brushes are fastened on the woven belt, which is operated by a rocker, as illustrated, and a mixture of pumice stone and water is fed from a sprinkler suspended from the ceiling. The piano backs are fed through the machine and thoroughly rubbed down to a fine degree of smoothness preparatory to receiving several coats of varnish. The position of the driven pulley on this machine precludes the placing of the motor at any place except on the floor.

It is worth mentioning that there lies idle in this plant a 90-hp engine which was previously used to transmit power through shafting to various wood-working machines. While there are no actual data at hand from which to make a comparison of the efficiency of the plant now installed with the old engine drive, yet it is known that when the engine was in use, working at its maximum output, there was delivered less than one-third the effective horse-power now utilized. Figures taken from similar plants equipped with the motor drive show a gain in efficiency ranging from 30 per cent to 60 per cent over the old method. The entire equipment of motors in the above plant was furnished by the Triumph Electric Company, Cincinnati, Ohio.

Electric Food Warmers.

The Simplex Electric Heating Company, Cambridge, Mass., has recently put on the market a line of electric food warmers to take the place of "hot-water plates," and instead of applying the heat to a variety of platters or dishes, they provide a heated stand for use in the dining room, on which the food dishes may be set and where they will be kept warm. They are in attractive design in nickel or silver plate, having a top surface in dull-finish aluminum, which is not easily scratched or discolored, and the top, with the heater attached, is removable to facilitate the cleaning or polishing of the plated portions. The temperature is limited so that there is ample heat for the requirements, and yet they are not so hot as to endanger the

ELECTRIC FOOD WARMER.

choicest china in being injured. The current consumption is such that most of the sizes can be connected to lamp sockets and the cost of operation is small.

These devices are made in a variety of sizes and designs, both oval and oblong, the top surface varying from 10 in. x 14 in. in the smaller sizes to 10 in. x 26 in. in the larger. They are furnished in moderate weights for domestic requirements and in extra heavy weights for hotel use. The Simplex Company report an immediate demand for these goods both for hotels, restaurants and domestic use. They have supplied them in quantities to such New York hotels as the St. Regis, Hotel Astor, Café Martin and others.

Reflector Hood for Tungsten Street Lamps.

The Wheeler Reflector Company, of Boston, Mass., has brought out a hood for series tungsten lamps for which certain

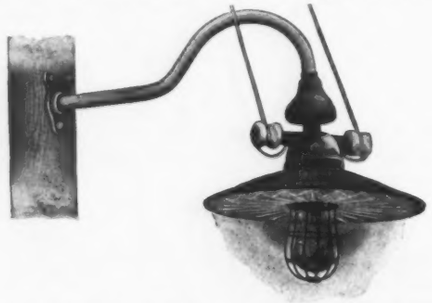


FIG. 1.—REFLECTOR FOR TUNGSTEN STREET LAMPS.

meritorious features are claimed. To protect the lamp against malicious breakage, a heavy wire guard is screwed into the

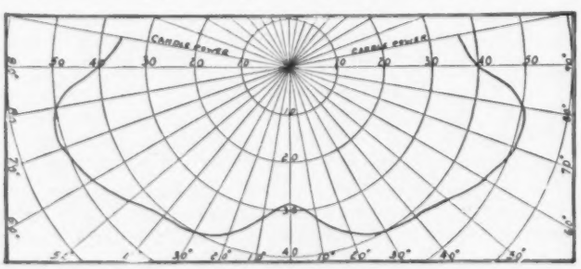


FIG. 2.—ILLUMINATION CURVE.

reflector, which is corrugated radially and gives a wide distribution of light, as shown by the curve herewith. The reflector is 18 in. in diameter and the hood being edged around its outer circumference, there is no tendency to strain the brittle glaze of the enamel reflector, as would be the case were the reflector suspended from nearer its center. The hood is finished off round and smooth to prevent snow or sleet lodging on top of the fixture. Moreover, the air space between the reflector and the hood insulates the heat of the lamp to such an extent, it is claimed, that any snow which happened to remain on top of the fixture would not melt from this cause. The fixture to which the hood is attached is provided with a triangular foot for fastening it rigidly to the pole and offsetting any tendency to sway.

Automobile-Driven Lighting Equipment.

Of the many interesting side features at the recent Vanderbilt Cup Race, on Long Island, one quite worthy of particular attention was the illumination of the parking space set aside for Maxwell owners by the Maxwell-Brisco Motor Company, of

NOVEL ELECTRIC LIGHTING EQUIPMENT.

Tarrytown, N. Y. This space was illuminated by 50 16-cp electric lamps furnished with energy, as shown in the illustration, by a small generator which in turn was driven by the rear wheels of a four-cyclinder Maxwell roadster. The generator was driven steadily for five hours at a speed of 1700 r.p.m., and the entire scheme proved thoroughly successful.

Small High-Voltage Transformers.

There has recently grown up a demand for small transformers to operate directly from high-voltage transmission lines for the purpose of supplying light and power to mills, mines, factories or other consumers. The use of such transformers is increasing rapidly, especially in the West, which is covered with the transmission lines of the great hydro-electric plants. In the East, also, there is a growing demand for transformers of this class, owing to the increasing tendency of existing plants to transmit power at high voltage to out-lying communities or neighboring towns.

The Pittsburgh Transformer Company has developed a line of high-voltage transformers in sizes from 5 kw up to 75 kw for use on all commercial voltages up to 60,000 volts. This line is in addition to the company's regular line of power transmission transformers, which are now manufactured in various sizes and voltages from 1000-kw capacity downward. The most important requirement in small-sized high-voltage transformers is that of reliability, for it is quite evident that the burn-out of such a transformer, causing a shutdown of a mine or mill, is too serious a contingency to be lightly regarded. The company, therefore, has devoted great care to this feature in its designs, with the result that the dependability of these transformers is stated to be even greater than that shown by standard low-voltage transformers. Special attention has been given to the mechanical strength of various parts, such as leads, bushings, arrangement of coils, etc., to the end that a rugged construction shall be secured.

As an example of this construction it may be mentioned that the primary leads issue from the transformer vertically upward through the cast-iron cover through heavy porcelain bushings. The bushings extend down into the transformer well below the

surface of the oil, so that the high-tension leads, after leaving the coils, enter the porcelain bushings, and until they leave the transformer, are either immersed in oil or surrounded by porcelain. This construction effectually prevents the troubles due to burned off leads on account of static discharges, lightning or surges in the line.

The insulation of these transformers has also received most careful study and investigation. All materials are absolutely dried before being used in the windings, and each piece is thoroughly coated with several layers of an insulating varnish thoroughly baked on. Moisture is, thereby entirely eliminated, and the dielectric strength of the coil insulation raised to an exceedingly high point. To further safeguard the transformers from an insulation standpoint, thorough ventilation is provided, not only between the low-voltage windings and the steel cores, but also between the low-voltage and the high-voltage windings. A sheath of cooled oil is, therefore, constantly flowing between

SMALL HIGH-VOLTAGE TRANSFORMER.

the two windings and the steel cores, as well as between the primary and secondary windings. Heretofore one of the great difficulties met with in the design of a small high-voltage transformer was the great sacrifice in efficiency necessitated by the unavoidable space consumed by the insulation. In these transformers, by the use of the new silico-vanadium steel, it is stated that efficiencies much higher than formerly have been obtained, so that the present small high-voltage transformers not only represent maximum efficiencies, but also embody rugged and durable mechanical construction.

Electric Coffee Grinder.

The electric coffee mill here shown has been introduced by the Coles Manufacturing Company, 1815 North Twenty-third Street, Philadelphia. It is intended for the use of establishments that do not desire to granulate more than 2 lb. of coffee per minute, and the mill is fitted with granulating grinders of that capacity. The fineness of the coffee can be regulated, while the mill is running, from coarse to fine; and when the grinders are adjusted satisfactorily they are firmly held in the proper position by a thumb lock screw. The grinders are made of a tough quality of cast steel. The mill is said to be the only one manufactured that breaks the coffee

COFFEE GRINDER.

bean before it enters the grinders, thus ensuring longer life to the grinder. It is equipped with an electric motor of ⅛ hp, at 1000 r.p.m., in any voltage, and either alternating or direct current. It is without a starting box, as being unnecessary, but is fitted with flexible cord and socket, ready to plug in. The mill is handsomely finished and nickel-plated.

Trolley Feeder Cable Support.

A new and improved combined feed-in and strain support for trolley feeder cables has been brought out by Dossert & Company, New York, and is shown in the accompanying cut. The device comprises a combination of the Dossert solderless cable tap with a regular soldered ear of the cap and cone type. The

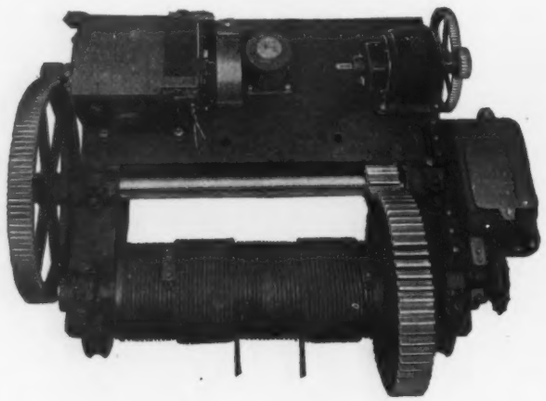
TROLLEY FEEDER CABLE SUPPORT.

feed-in tap is made with a standard threaded stud which screws into the ear, a jam-nut and lockwasher holding the tap securely in place against the boss of the ear. The advantages claimed for the device are that it eliminates the process of soldering the feeder cable or fastening it with screws; it gives contact throughout its entire length instead of at three points as in the

case of a yoke; it does away with bending and "checking" of the feeder by receiving it in a perfectly straight line; it acts as a strain support, is very strong and compact, and cannot work loose. The tap is bored to take No. 2-0, 3-0 or 4-0 round wire or stranded cable and has either a 5/8-in. or 3/4-in. stud.

Compact Electric Crane.

The use of electric cranes has grown rapidly, and their introduction goes on apace. The accompanying view shows a five-ton trolley installed on one of the three cranes at the plant of the Eastman Kodak Company, Rochester, N. Y. These cranes were built by the Cleveland Crane & Car Company, of Wickliffe, Ohio. It is a very simple machine arranged in a compact manner. The motors were built by the Crocker-Wheeler Company, of Ampere, N. J., the hoist motor being of the box type and the rack motor of the circular type. The hoist motor is a



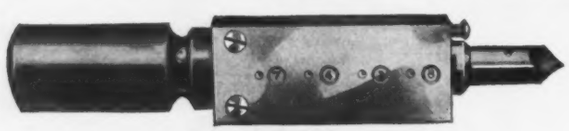
ELECTRIC CRANE.

7-hp machine and the rack motor 1½ hp. Both are very compact and take up practically no room on the crane. At the same time they are easily accessible.

A feature of the crane is the mechanical brake, which is of the pawl type with friction disks, and operates in a submerged oil bath.

Revolution Counter.

A new type of revolution counter, known as the "Initiative," has recently been put on the market by Messrs. Schuchardt & Schutte, New York. This instrument, as shown by the accompanying illustration, gives the revolutions as an ordinary number, thus obviating the possibility of confusion and inaccuracy in reading likely to arise with counters in which the speed is taken on a graduated disk. Another feature is the arrangement for instantly setting the count back to zero. Right- and left-hand revolutions are recorded by shifting a small pinion from



REVOLUTION COUNTER.

or to the holes marked *R* and *L* at the back of the counter. Left-hand revolutions are thus not read backward, but forward, as in the case of right-hand revolutions.

The interior mechanism of the counter is composed of four dials, each containing the figures from zero to 9, fitted with a 10-tooth gear and connected by means of flat springs supplied with lugs that fit into the teeth of the adjoining pinion. The cam on the driving spindle revolves the unit dial, each entire revolution of which picks up one tooth of the tenth dial. One revolution of this dial engages a tooth of the following dial and the count is thus recorded evenly and accurately without skipping or jumping. Three and four thousand revolutions per minute are recorded as accurately as 500. When the count reaches 10,000, the instrument automatically repeats.

The instrument is 4 in. in length and 1 in. wide. The handle is of hard rubber and the body of polished steel. The count is set back to zero by means of knurled screws at the back. A small plush-lined leather case is furnished, so that the device can be comfortably carried in the pocket.

Electrical Equipment in a Lead Plant.

The plant of the Raymond Lead Company, recently built in Chicago, has a very complete electrical equipment, both for lighting and motor drive. A 220-volt direct-current system is used, the company having built its own generating plant. There are two generators, one of 150 kw and one of 45 kw, of Allis-

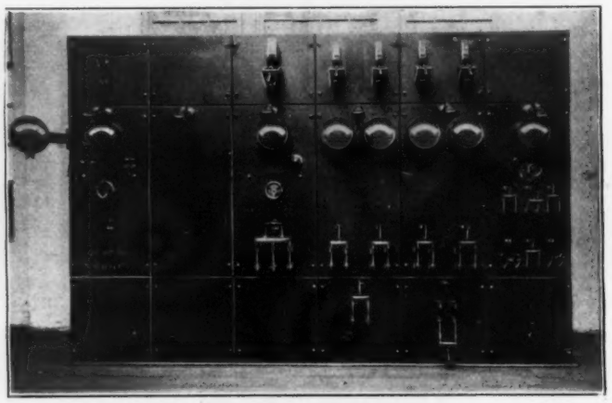


FIG. 1.—VIEW OF SWITCHBOARD.

Chalmers manufacture. The larger generator is direct-connected to a Harrisburg tandem-compound engine running 200 r.p.m. The smaller generator is direct-connected to a simple engine. The larger unit is seen in Fig. 2. The engine room, and, in fact, the whole plant, is characterized by plenty of light, room and air.

For driving the various machines 24 motors, aggregating 325 hp, have been installed. Most of the factory lighting is done by Cooper Hewitt mercury-arc lamps. There are 56 of the short type of lamp and 24 of the long type. There are also 170

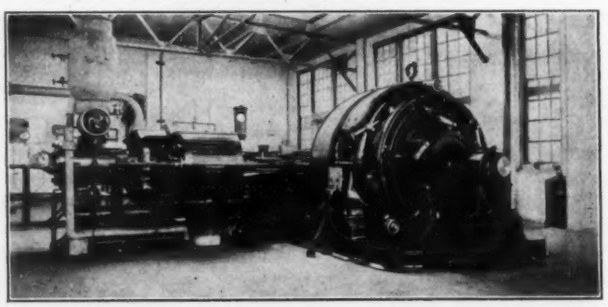


FIG. 2.—VIEW OF ENGINE AND GENERATOR.

incandescent lamps in various places. The plant covers 59,000 sq. ft. of ground, with a basement and two floors. The switchboard (Fig. 1) has a panel for each generator, two power feeder panels and one lighting feeder panel. Each power feeder panel has two feeders, each of which has a double-pole knife switch, an ammeter and a circuit-breaker. On the right-hand feeder panel a double throw knife switch is provided at the bottom for the purpose of dividing the busbars in case it is desirable to operate one part of the plant from one generator and another part from another. The six lighting feeders on the

right-hand panel each have a double-pole switch, and an ammeter switch is provided whereby any one of these circuits can be connected to the ammeter at the top of the panel.

This switchboard and the cut-out cabinets illustrated later were built by the Eaton Electric Manufacturing Company, of Chicago. The contract for the wiring of the factory was carried out by the Lounsbery Brothers Company, of Chicago. The

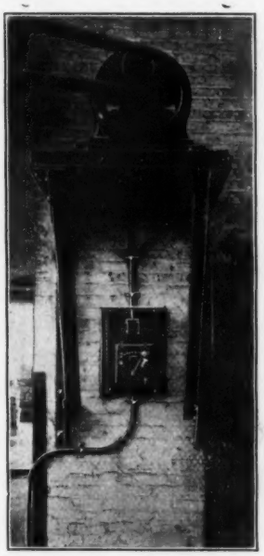


FIG. 3.—TYPICAL MOTOR INSTALLATION.

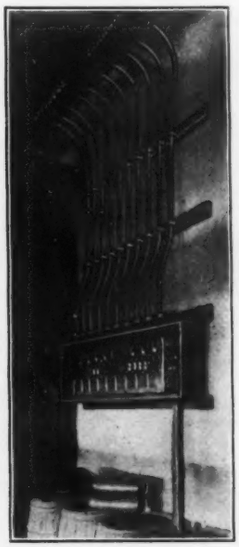


FIG. 4.—CONDUIT AND CLEAT WORK.

general character of the wiring is knob or cleat work overhead, with conduit on walls and vertical runs.

Fig. 5 is a typical arrangement of distribution cut-out box, with the main feeder to the box entering from below and the branch circuits leaving from the top. The box is of steel, with the door opening upward so as to close by gravity. Each branch circuit has simply a pair of enclosed fuses, no switch being placed in the cut-out box. At the ceiling where the transition from conduit to open work is made, "Condulet" fittings

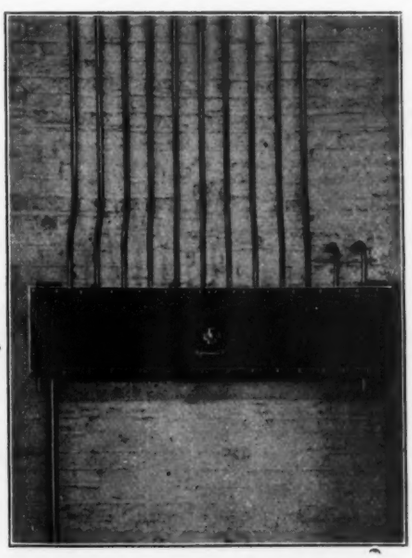


FIG. 5.—TYPICAL DISTRIBUTION CUT-OUT BOX.

are used, as seen in Fig. 4. There are three main cabinets for power-circuit distribution. From these cabinets one branch circuit goes to each motor.

The largest motor is one of 75 hp operating a large lead roller. The control board of this motor is equipped with Westinghouse contact makers similar to those used in electric railway service.

Besides the direct-current motors operating in the factory there are two vertical shaft single-phase alternating-current motors connected to Yeomans centrifugal pumps left in circuit continuously for automatically draining a sump into which the building drainage flows, this sump being below the city sewer level, so that all sewage has to be elevated a few feet from the sump to the sewer. These two motors are connected on the Commonwealth Edison Company's circuit so as to operate night and day.

Fig. 3 shows a typical direct-current motor installation for line-shaft driving, the motor being mounted on a substantial wall bracket or platform with the starting box underneath.

Alternating-Current Motor Brakes.

Electromagnets using alternating current require considerably greater expenditure of volt-amperes for a given braking effect than do those using direct current. Moreover, as a general rule, the fly-wheel effect of the rotors of alternating-current motors is greater than that of direct-current motors of corresponding rating, so that alternating-current motors require greater braking effect. Again, the use of alternating current requires a laminated iron magnet core, thus increasing the cost of construction. To these facts is due the difficulty in designing successful alternating-current motor brakes.

In the brake illustrated in Fig. 1 the magnet coils are form wound, impregnated and baked, thus becoming solid waterproof masses. The coils are usually wound for 100, 200, 400, 550, 1000 and 2000 volts, but by means of taps, adjustments can be made so that the coils will operate on voltages between limits 10 per cent above or below these standards; the taps also afford means of adjusting the magnetic pull. Each brake has two coils, connected in series with each other and in shunt across one phase of the motor circuit. Current is admitted to and cut off from the brake coils and the motor primary simultaneously.

The coils are mounted on opposite legs of a laminated iron core that forms a complete magnetic circuit. A plunger rod carrying the weights and connected to the toggle mechanism, passes between the coils and through opposite legs of the magnet core.

The braking force is applied by the weights attached to the plunger rod and acting through the toggle mechanism. A buffer spring on the lower end of the plunger rod allows the braking force to be applied gradually so as to bring no undue stress on the brake and motor. When the motor is operating, current

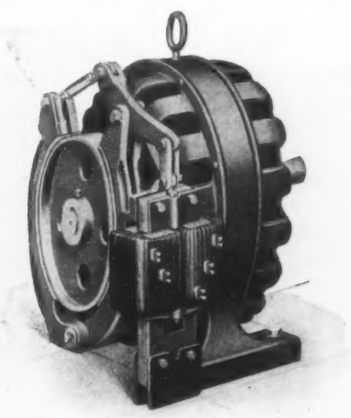


FIG. 1.—TWO-LIMB ALTERNATING-CURRENT BRAKE MAGNET.

passes through the magnet coils, the plunger is drawn up and the brake shoes spread apart through the action of the toggle mechanism, thus freeing the brake wheel. In stopping the motor, the brake circuit is opened, the plunger and weights descend, and the shoes are clamped firmly against the wheel.

In the brake shown in Fig. 2 the magnet core is built with three legs of sheet-steel punchings. The coils are mounted on

the two outer legs, the inner legs being common to both magnetic circuits. The core is divided horizontally in the middle. The lower half is stationary and is attached to a projection from the brake frame; the upper half is movable and is at-

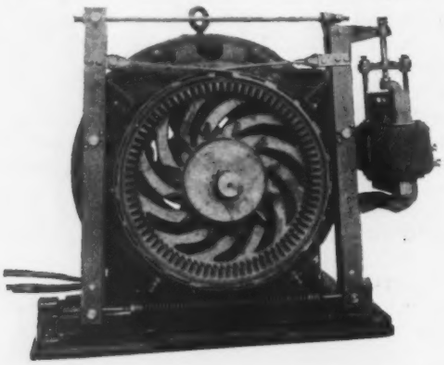


FIG. 2.—THREE-LIMB ALTERNATING-CURRENT BRAKE MAGNET.

tached to the lever by which the brake is operated. The coils are mounted on the lower half. When the brake is applied the upper half is raised to its highest position, and a gap of from 1½ in. to 2 in. exists between the two parts of the core.

The lever connecting the movable part of the core with the brake beams is L-shaped and is so connected to the beams that when the long arm of the "L" is pulled down by the magnet the tops of the beams approach each other, thus releasing the brake.

When the motor is operating and current is in the coils, the upper part of the core is pulled down, the brake is released and the spring elongated. On stopping the motor, the brake circuit is opened, allowing the spring to contract and apply the brake.

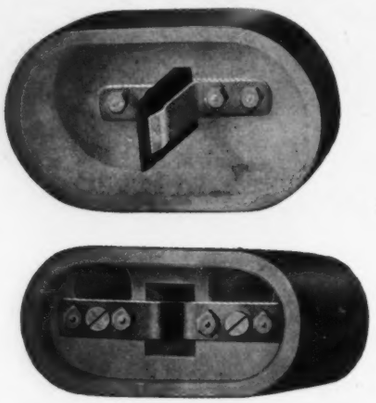
It is claimed that the value of volt-amperes required to operate these electromagnets is exceptionally small considering the large torque, and that the brakes make little noise in operation. They are built by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

Combination Pothead and Series Arc Cut-Out.

The G. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago, which manufactures a number of porcelain pothead and cable terminal devices, is just bringing out a porcelain pothead which also answers all the purposes of a complete arc-lamp cut-out for series circuits. Being of porcelain,

FIGS. 1 AND 2.—COMBINATION POTHEAD AND CUT-OUT.

there is not the serious difficulty of maintaining insulation that there is with cut-outs located in iron boxes in damp places. It is suited for use in the base of an iron lamp-post or in manholes. It is also suited in modified form for overhead work. The body of the cut-out is porcelain, and consists of two parts. Fig. 1 shows an underground type. The lower part has two openings through which the lead-covered cables pass. The cable terminal is soldered into a lug, and the lug is secured in place by a nut in the pothead. The space around the cable and lug is then thoroughly sealed by filling with hot compound. The interior of the lower part, which forms a receptacle, is shown in Fig. 4. The upper part, which contains the plug, Fig. 3, protects the lower part from the dripping of water and carries the connections for the lamp leads. These lamp leads are also soldered to removable lugs, and moisture is excluded by pouring in compound and by a substantial wrapping of tape. On the lower or receptacle part two phosphor-bronze springs keep the circuit closed when the cap is off. When the cap is on, the plug seen in Fig. 3 enters between the springs, forcing them apart, so that the current flows through the lamp. Since the upper part laps over the lower, a closed air chamber is formed so that the pothead can be submerged in water without breaking down. The disconnection is absolute when the cap is removed. The contacts close the circuit before the plug opens. This can be shown by an operating test with an ammeter in series. The same principle is used for the overhead arc cut-out, shown in Fig. 2. The receptacle of this cut-out is the



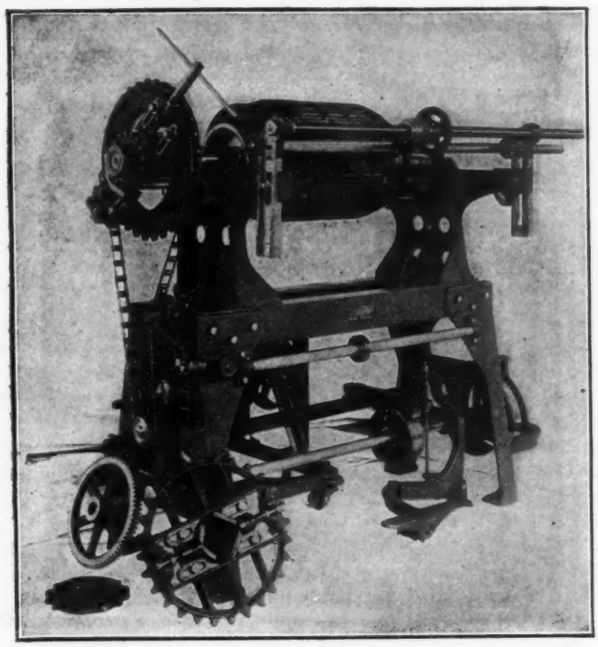
FIGS. 3 AND 4.—INTERIOR VIEWS OF POTHEAD AND CUT-OUT.

underground cut-out turned bottom side up. The plug part has no petticoat, so that the water running off the receptacle cannot enter it. In many cases it is necessary to have a pothead at the termination of an underground cable in any event, and this device combines the pothead and arc cut-out in one appliance, thus doing away with the dangers and expense of a separate cut-out in an iron box.

Banding Machine for Armatures.

The illustration herewith shows the new banding machine made by the Device Improvement Company, of Hanover, Pa. The improvements are those suggested by three years' use and operation in the largest electric railway shops in this country. The new machine is somewhat lower than those first produced and the legs are very much heavier. The foot treadle has been made very much more convenient for the operator by bringing it out further and making the foot piece longer, so that it can be reached from any part of the machine. The brake to hold the armature against the tension of the band wire, a most successful and important feature, remains practically the same. The driving shaft, however, has been made heavier as well as the yoke supporting the back end of this shaft and the belt shifter rod. The adjusting hand nut for the chain idler has been placed in front of the machine instead of the back. The rod carrying the lower traveling grooved pulley has been made much larger, preventing any spring. The bed pieces are now double the size, and are accurately planed to a perfect surface. The heads are now practically doubled in weight and are machine-fitted throughout. The feed rod supported from the heads is 1½-in. cold-rolled steel with square threads the whole length; and on account of the coarser pitch of these threads, it is possible to feed from band to band much more quickly. The

position of this rod can now not only be adjusted vertically, but in and out, to suit the convenience of the operator and the size of the work. The feed wheel is larger and machined all over, permitting a better grip for faster feeding. The left hand head is now made adjustable along the bed, the same as



BANDING MACHINE.

the right hand head, thus obviating the use of any set collars. Two sprockets are now supplied, one for application directly on the shaft and holding by friction, while the other is applied on the pinion and has a projecting tooth which engages between the teeth of the pinion. This of course makes a positive drive. The pinion sprocket is used exclusively for railway armatures, while the friction sprocket is used for stationary armatures as well as for air compressor armatures. Four changes of speed are now provided, two by change of gears and two by change of small sprockets. The gears have machine-cut teeth from the solid metal. The driving chain is now larger and the breaking strain is 2000 lb. The field coil-winding attachment has also been improved in detail. In other words, the whole machine has been doubled in weight and strength, and many valuable features added for convenience, speed, ease of operation and higher quality of work.

Hospitalier-Carpentier Indicator for Gas and High-Speed Steam Engines.

Some years ago the late Prof. Hospitalier devised an instrument for taking indicator cards from steam engines of high speed and from gas engines, primarily designed to obviate the objections to the use of the Watt form of indicator for these purposes. Owing to the inertia of the movable parts, the latter type of indicator is unsatisfactory when applied to very high-speed engines, and when applied to gas engines the great range of variation in the pressures gives rise to oscillations that falsify the indicator card. The indicator is also applicable to the study of steam-turbine pressures. The Hospitalier device was perfected mechanically by J. Carpentier, proprietor of the celebrated Ateliers Rhumkorff, Paris, and is now known as the Hospitalier-Carpentier Manograph.

This instrument utilizes a luminous ray as the card tracer. A small mirror rests on three points, forming a right-angled triangle, a fixed point being at the right angle and two movable points at the other two angles. One of the movable points is connected with a manometric diaphragm, subject to the pressure of the steam or gas in the cylinder, and the other reproduces on a small scale the reciprocating motion of the piston. The resultant of these two motions traces the indicator diagram on

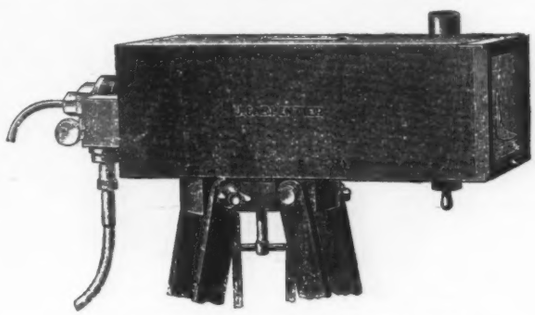
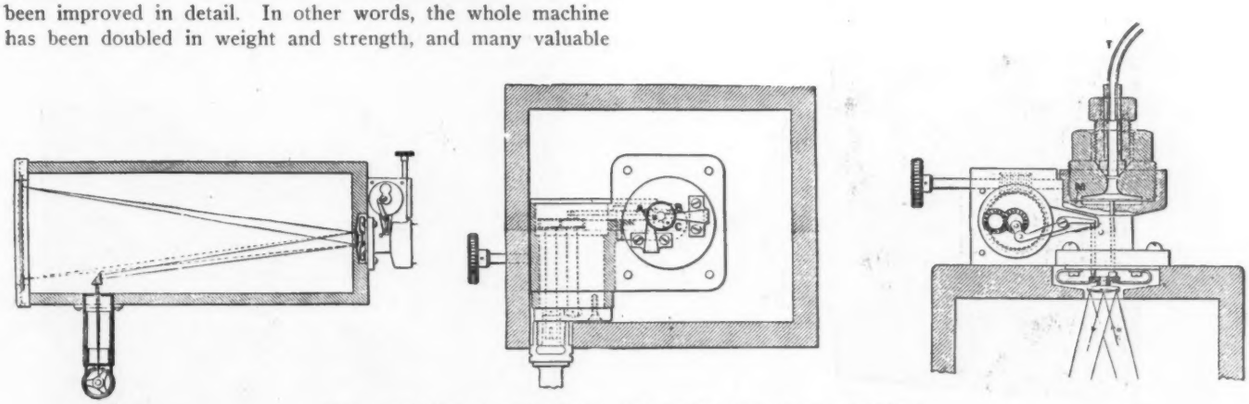


FIG. 1.—PERSPECTIVE VIEW OF INDICATOR.

a ground-glass surface or on a sensitized photographic plate. For speeds greater than 1200 r.p.m. the trace of the card is, as shown in Fig. 1, perceptible to the eye, but for lower speeds the card is fixed by photographic means.

A view of the apparatus is given in Fig. 1 and a cross-section, in Fig. 2, which latter shows the light-reflecting arrangement. Figs. 3 and 4 represent the mechanism in detail. In Fig. 4 the mirror is shown below the pressure diaphragm *M*, the piston-motion part of the device being to the left. This latter is connected by a flexible shaft to the engine indicated, an intervening planetary gear being employed to transmit the piston motion to the mirror lever. This gear admits of a very simple method of establishing synchronism between the motion of the piston and that of the lever acting on the mirror. As stated before, a ray of light from the mirror traces the curve of pressures, which in the case of high speeds of revolution can be observed continuously on a ground-glass plate, or traced thereon with a pencil; in the case of both high and low pressures the luminous trace can be photographed.



FIGS. 2, 3 AND 4.—SECTIONAL AND DETAIL VIEWS OF INDICATOR.

The American representative for the Hospitalier-Carpentier Manometer is Hugo C. Gibson, 630 West 135th Street, New York.

Recording Instruments for Alternating-Current and Direct-Current Circuits.

The curve-drawing instruments illustrated herewith have been developed for recording the load conditions in central stations. The line includes recording voltmeters, ammeters, single-phase and polyphase wattmeters and power-factor meters for alternating-current circuits and ammeters, voltmeters and wattmeters for direct-current circuits.

The alternating-current voltmeters, ammeters and wattmeters are constructed on the direct-reading-dynamometer principle, while the ammeters are constructed on the magnetic-vane prin-

FIG. 1.—DIRECT-CURRENT RECORDING AMMETER.

ciple. The direct-current voltmeters and wattmeters are the same as the alternating-current instruments with the exception that they are calibrated on direct current. The direct-current ammeter has the same general mechanical construction as the alternating-current instruments.

It is claimed that in these instruments, friction has been reduced to a very low degree, being only that of the recording pen on the paper. A device is provided for holding the moving element and pen arm in place during shipment.

The pen is provided with an iridium point sealed into a very small glass tube, which in turn is placed inside a larger tube, the latter terminating in a bulb which holds sufficient ink to operate the pen seven days without re-filling. The record is made on a band of specially prepared paper 60 ft. in length. The recording pen is attached to the moving element in such

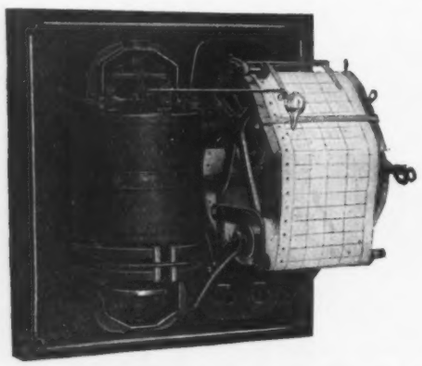


FIG. 2.—ALTERNATING-CURRENT RECORDING WATTMETER, WITH COVER REMOVED.

a manner that its motion is transmitted in a straight line parallel to the time divisions on the chart.

For driving the chart an eight-day clock of simple and rigid construction is used. It is self-contained and easily regulated. By means of suitable gearing, the clock drives a drum having peg teeth which engage the holes located near the edge of the chart. These teeth not only feed the paper under the recording pen, but also give it a definite and accurate position along the axis of the drum. The pen arm fluctuations are magnetically damped by means of a disk of aluminum passing between the poles of permanent magnets. This method of damping is claimed to be very effective.

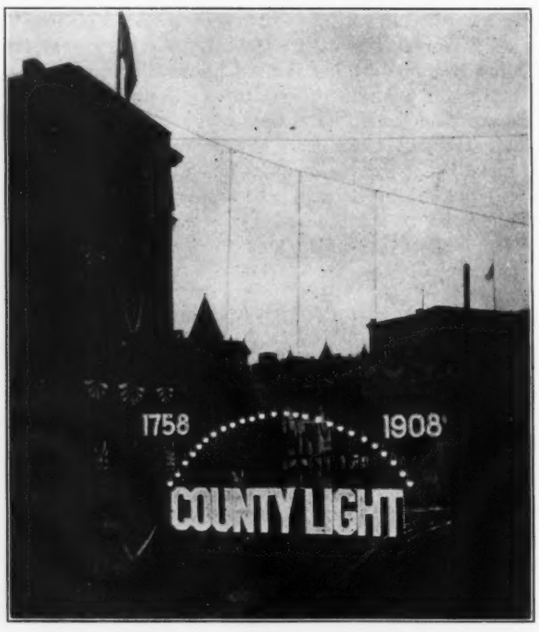
The direct-current recording ammeters are constructed according to the astatic principle, and are of the electromagnet type. The moving element consists of two rectangular-shaped coils connected together with two soft sheet-steel astatic control pieces fastened between them. The current to be measured, or a shunted portion of it, is passed through the coils which are free to move in the field set up by two astatically arranged electromagnets.

These instruments are made by the General Electric Company, Schenectady, N. Y.

Flaming Arc Lamps for Decorative Illumination.

One of the most elaborate examples of electrical display ever designed and installed by a central station for its own use was contributed by the Allegheny County Light Company, of Pittsburgh, Pa., to the recent celebration of the one hundred and fiftieth anniversary of the founding of the city of Pittsburgh. This sign, which is shown in the accompanying illustration, was suspended 60 ft. above ground from cables running from the company's building across Sixth Avenue, and could be seen for a mile and more up and down that busy thoroughfare. Three thousand two hundred 16-cp incandescent lamps were used to form the letters and figures, while 26 Grant flaming arc lamps, manufactured by the German-American Electric Company, New York, giving a candle-power of 4000 each, were suspended in an arch above, from sidewalk to sidewalk across the street. The total candle-power of this mammoth sign was over 150,000.

The Allegheny County Light Company, believing in the aggressive development of the use of flaming-arc lamps and electric



FLAMING-ARC LAMPS FOR DECORATIVE ILLUMINATION.

signs, has carried on a vigorous campaign in this direction, as is witnessed by the many spectacular signs now installed in Pittsburgh for the illumination of which flaming-arc lamps, as well as incandescents, are used. A corps of experts is employed for the development of this branch of decorative illumination, and the results so far achieved prove the practicability of a very extensive use of flaming-arc lamps and electric signs for outside store illumination. Even at present the business sections of Pittsburgh rival the "White Way" of New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The week before election is never one in which a great amount of business is transacted. The past week was no exception to this rule. General conditions are still encouraging, but actual increase in trade is small. Retail trade has been irregular throughout the West on account of unsettled weather. In wholesale lines there has been little done except in filling-in orders. The current distribution of goods for the season is considerably less than at this period of 1907. Probably the most activity in wholesale distribution at present is in cotton goods for the spring and summer trade, but even in this line many orders are reported to be conditional upon the result of the election, and it is intimated that some of these are merely speculative orders placed with the intention of being filled should Mr. Taft be elected and in being cancelled if he should not be successful. Those who placed such orders are doing so expecting to reap the profit of higher prices without taking any risk. In woolen goods and the clothing trade there is general quiet, and the season's business has been disappointing. This was largely due to unfavorable weather conditions. Raw wool, however, is selling actively in the Boston market, and this indicates that the manufacturers are preparing for a large business in the future. Crop reports are somewhat irregular and there has been some interference with the planting of winter wheat throughout the Central West and South, on account of the excessive dry weather. While the cotton crop is being ginned rapidly, it is to a large extent being held by the planters on account of the prevailing low prices. The result of this is that collections throughout the South are not as good as they were in some other portions of the agricultural belt. Cereal crops, as a rule, are being moved to market with unusual rapidity, and as prices are high producers in the West are prosperous. In industrial lines there is little improvement so far as the reemployment of labor goes, but it is very evident that all the large concerns are clearing their decks for immediate action after the election. The quarterly report of the United States Steel Corporation, showing an increase of about $7,000,000 over the previous quarter, has had a distinctly encouraging effect upon the entire industrial community. It shows that a well-managed concern, even when employed to only 60 per cent of its full capacity, can earn handsome returns upon an unusually large capitalization and still add something to its surplus. Pig iron continues to be dull, and prices are certainly no stronger. The coal trade is somewhat restricted owing to the mild weather that has prevailed all over the country. A fair trade is being done by the flour millers. Grocery orders are somewhat better than they were a month ago, and the packing houses are fairly busy. The building trade continues to improve, and the lumber industry, which has been conspicuous throughout the fall for its activity, seems to be running at present at full capacity. The most encouraging feature of the entire situation in trade is the evident condition of waiting, in which all lines are indulging. Every one expects to be busy by the middle of November. Business failures for the week ended Oct. 30, reported by *Bradstreet's*, were 241, against 231 the previous week, 223 for the like week in 1907, 163 in 1906, 160 in 1905, and 200 in 1904.

THE COPPER MARKET.

The buying movement in copper, which began early in October, has continued, with the result that the copper market is at present in much better position than it has been at any other time since the business depression began, a year ago. It is estimated that during the month of October the buying for both domestic consumption and export amounted to 100,000,000 lb., which is about the same as the production. There will be, therefore, no surplus to be added to the already heavy stocks. During the month some of the largest domestic consumers went into the market heavily. The electrical companies, wire drawers and brass founders were all liberal buyers. They came into the market early and in many instances secured metal at 13¼ cents for electrolytic. These purchases were made for October, November and December delivery and it is said that in some instances deliveries were secured for January. Producers, however, were not anxious to make contracts running into 1909, and it is considered doubtful if any sales for delivery so far in the future were written at the prices quoted above. It is understood, of course, that the recent purchases by manufacturers were not made for the purpose of securing raw material with which to fill orders already received, but were largely in anticipation of orders expected. There is every indication that business will soon be heavy in the electrical and brass industries, and the manufacturers are not averse to taking advantage of low prices, even if such buying is somewhat in the nature of speculation. It is very different speculation, however, from that which has prevailed during the past six months, both in this country and Europe. In the latter instance millions of pounds were purchased on standard warrants by interests that do not consume copper and had no intention of ever accepting the actual metal. In the meantime, there is a general buoyancy of tone in the market which adverse statistics have not been able to discourage. There seems to be absolute faith in the resumption of business and full confidence that the prices of the metal will go higher. Leaders in the market express assurance as to the future and satisfaction with the present condition. John D. Ryan, managing director of the Amalgamated company, says: "The metal market has shown marked improvement during the last week and large sales of copper have been made at slightly advanced prices. One of the most encouraging features of the recent large sales of copper is the fact that most of the metal has been sold for domestic use. Mines are in full operation and there is no accumulation of copper." John R. Stanton, treasurer of the Mohawk and interested in many other Lake Superior properties, says: "The copper situation is strong, with prospects of still greater improvement before the first of the year. Home consumption is from 75 to 80 per cent of normal, and the prediction of 15-cent copper by Jan. 1 does not seem far fetched. Lake copper is offered at 13⅞ to 14 cents, with very little on the market under the first-named figure. With a sudden upward turn consumers will come tumbling into the market and bid the price up on themselves." Exports for the month of October, lacking two days, were 19,977 tons, and imports during the same period were 3,619 tons of copper and 10,005 tons of ore. Prices quoted on the Metal Exchange on Oct. 31 were:

Lake	13¼ @ 14
Electrolytic	13½ @ 13¾
Castings	13¼ @ 13½

The London market Oct. 30 was:

	Noon. £.	s.	d.	Close. £.	s.	d.
Standard copper, spot	61	16	3	61	16	3
Standard copper, futures	62	12	6	62	12	6
Market	Firm.			Firm.		
Sales of spot				600 tons		
Sales of futures				1,000 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	5	0
London, futures	64	10	0	56	17	6
London, best selected	67	10	0	60	0	0

WESTERN ELECTRIC CHANGES.—A series of very important personal changes in the management of one of the largest electrical manufacturing concerns in the world was rounded out last week in Chicago, at a meeting of the directors of the Western Electric Company. The veteran, Enos M. Barton, retired as president and became chairman of the board of directors. He was succeeded as president by H. B. Thayer, who has had his residence in New York City and will continue to reside there. Mr. Barton retires after many years in the service of the Western Electric Company. It was officially announced at the meeting of the directors that the company was engaged in consolidating its manufacturing business at its Hawthorne plant in Chicago. It is removing to that plant the manufacturing carried on heretofore at Clinton Street in Chicago, and part of the manufacturing which has been conducted at the company's factory in New York City. Some of

the engineering and other administrative work of the company will be conducted at New York. This is announced to be for the purpose of avoiding duplication between the Chicago and New York offices and between the engineering department of the company and the telephone companies, its principal customers. The publicity department, under H. M. Post, has already been moved to New York. Aside from the elevation of Mr. Thayer to the presidency other changes were made. H. A. Halligan and F. R. Welles were elected vice-presidents. William P. Sidley was elected vice-president and general counsel. George C. Pratt was elected secretary. Mr. Thayer has been connected with the company for 28 years. Mr. Halligan has been for a number of years secretary and in charge of a large part of the American business. Mr. Welles has been connected with the company for more than 30 years, and has charge of the foreign business, residing in Paris, but making frequent and extensive trips all over Europe, with occasional visits to this country. Mr. Sidley has been acting as counsel for the company and will continue so to act. His office of vice-president will not involve severing his connection with the firm of Holt, Wheeler & Sidley, of which he has been a member for some years.

HUDSON RIVER POWER COMPANIES RECEIVERSHIP.—Eben H. Gay, of Gay & Company, of Boston, who recently went into bankruptcy, and Joseph W. Jackson, of Boston, have filed an equity suit in the United States Circuit Court here and asked to have a joint receiver appointed for the following power and electric companies: Hudson River Electric Power Company, Hudson River Water Power Company, Hudson River Electric Company, Saratoga Gas, Electric Light & Power Company, Ballston Spa Light & Power Company, Empire State Power Company, Madison County Gas & Electric Company and Hudson River Power Transmission Company. The companies represent a combined capital of $15,000,000. They furnish light and power to Troy, Albany and Utica and to the General Electric Company at Schenectady and other large manufacturing concerns. This power originates at the dams at Sparrow Falls and Mechanicsville. The main office of the Hudson River Electric Power Company, the largest of the defendant corporations, is at Glens Falls. The complainants allege insolvency, mismanagement and mingling of funds. It was alleged that the transmission company had defaulted the interest on its bonds to the amount of $302,142 and that the Hudson River Electric Company had liabilities amounting to $823,212. The Saratoga and Ballston companies are both said to be insolvent and the property of all the defendants is practically in the possession of the Hudson River Electric Power Company. An effort had been made to combine all these companies, all the funds were paid to a common treasurer and the profitable companies contributed to the unprofitable. A bondholders' committee has been formed, and this joined in the prayer for a receiver. Judge Ray, before whom the application has been made, intimated that a receiver would be named. At the time the application was made the contending interests could not agree upon a recommendation.

TRANSFERS ORDERED IN NEW YORK CITY.—The Public Service Commission of the First District, after exhaustive hearings, has ordered the Metropolitan Street Railway and the Central Park, North & East River Railroad Company—the Fifty-ninth Street crosstown line—to restore transfers on the old basis. The order is to take effect Nov. 22, and the managements of the roads are given until Nov. 6 to inform the commission whether they intend to obey the order or not. The order of the commission, if obeyed, will restore the transfer privilege as it was prior to its abandonment of the lease of the crosstown line by the Metropolitan, except that only passengers boarding Metropolitan cars between Thirty-fourth and 116th Streets will be entitled to transfers. The order provides that of each 5-cent fare on which a transfer is issued the Metropolitan company shall receive 3¾ cents and the crosstown line 1¼ cents. The result of this action on the part of the commission will probably be a long drawn out legal contest which may be eventually carried to the highest courts. Mr. John G. Milburn, of counsel for the receivers of the Metropolitan company, has already stated that the order would be contested in the courts. Just what form the court action will take has not yet been determined. Under the law a penalty of $5,000 a day can be imposed for violation of the commission's order.

BOSTON ELEVATED MERGER HELD UP.—At a lively meeting of the stockholders of the West End Street Railway Company, in Boston, Oct. 28, by a vote of 111,009 shares to 72,905 shares, it was determined to petition the Legislature to modify the act under which the company obtained permission to consolidate with the Boston Elevated Railway Company. The West End Company stockholders want the second preferred stock of the Boston Elevated, which is to be exchanged for the former's stock, to bear 8 per cent instead of 7 as provided for in the act. The consolidation has not gone into effect yet, and will now be held up until the proposed amendment has been acted upon by the lawmakers. Any ultimate failure of the two companies to adjust their differences would, of course, result in a division of the present unified system and give Boston two distinct operating street railway systems. In the event of a segregation and contest following, the Boston Elevated would appear to have the primary advantage, as its present elevated and prospective Cambridge subway franchises are perpetual, while the franchises of the West End Street Railway surface lines are revocable. The free transfer system now in vogue might not only be discontinued if they were separate, but double fares from many points would naturally follow.

NEW LONG-DISTANCE TELEPHONE SYSTEM.—Mr. James B. Hoge, secretary of the United States Telephone Company, at Cleveland, has announced that plans are being made to organize a long-distance telephone system in opposition to the Bell interests. The men behind the plan propose, with the assistance of local telephone companies, to spread a new system all over the United States and to give long-distance service. Mr. Hoge announces that the holding company will be incorporated at once with $10,000,000 capital stock. "The new system will fill up long-distance gaps between Cleveland and Philadelphia and St. Louis and St. Paul," Mr. Hoge says. "It is proposed to do general telegraph business over the same lines. We will operate not only in the Eastern half of the continent, but the West as well. The capital is all to come from a syndicate composed of Eastern and St. Louis capitalists." The Keystone Telephone Company, of Philadelphia, is interested in the new project, and its directors have held several meetings to consider the matter. It is said that eventually more than 20,000 miles of wires and poles will be in the combination's lines.

CLEVELAND TRACTION AFFAIRS MUDDLED.—The condition of traction affairs in Cleveland since the defeat of the Municipal plan at the recent election is badly complicated. On Oct. 28 a new suit, which is expected to take precedence over all the other suits, was filed in the United States Court at Cleveland by the Central Trust Company, of New York. This company is trustee under the three mortgages issued on the old property of the Cleveland Electric Railway. The petition asks that the court take charge of all of the local street railway property. Both the Municipal Traction Company, the operating company, and the Cleveland Railway Company, the owning company, were made parties to the suit. A temporary restraining order also was issued enjoining the companies from paying out any money or contracting any new obligations other than paying for labor and the actual maintenance of the property.

HUDSON TUNNEL EXTENSIONS.—The question as to the extension of the Hudson tunnel up Sixth Avenue, New York, having been raised by the merchants of that section, Mr. Wilber C. Fisk, the vice-president, has explained that it is the intention of the company to eventually open stations at Twenty-eighth and at Thirty-third Streets. Nothing definite will be done in this direction, however, until the Cortlandt Street tunnel and terminal are completed. This work, he said, was being pushed as rapidly as possible, and that before many months he felt confident that the company would be able to begin work at Twenty-eighth and Thirty-third Streets. As to the latter station, he said: "This is as far north as we expect to go at present. We shall have there one of our most commodious stations. From it it will be possible for travelers to check their baggage to any point in the United States."

BOILERS FOR PANAMA CANAL WORK.—E. Keeler & Co., Williamsport, Pa., have been awarded a contract by the Isthmian Canal Commission for twelve 410-hp Keeler water-tube boilers, to be used to operate the cable-ways and other machinery for the buildings of the locks and dams at Gatun and Miraflores. This is the largest boiler order yet placed for the government for Panama Canal work, and the boilers will be used in the permanent operation of the canal, when opened. The D'Olier Engineering Co., Philadelphia, is the general contractor for this steam plant, which also includes Foster superheaters and Ajax shaking grates, made by the Valley Iron Works, Williamsport.

YAKIMA VALLEY POWER COMPANY, incorporated for $300,000 and headed by Robert E. Strahorn, of Spokane, Wash., president of the North Coast Railway Company, announces that its electrical power and transmission system will reach every town in the Yakima Valley from North Yakima to Pasco, Wash. Its contracts call for delivery of light and power at Kennewick and Pasco by next April, but the company expects to have its steam power plant, with a capacity of 1,000 hp, in commission at Kennewick in 30 days. Among the places to which the power line will be built are Yakima, Wapato, Toppenish, Zillah, Granger, Sunnyside, Grandview, Mabton, Prosser, Kiona, Richland, Kennewick, Finley, Hoover and Pasco. The project is intended to furnish electric light and power to the cities mentioned, also to operate a number of irrigation plants completed and to be established in that territory. The company has under construction a 90-mile high-tension line extending from its power plant on the Naches River near Yakima to Pasco. It has acquired the power systems in Kennewick and Pasco. The line is designed to convey 10,000 electric hp. From the plant to Pasco is 90 miles, and the aggregate length of the lines will be 100 miles when various branches to nearby towns are built. The Northwest Light & Water Company's plant on the Naches River, 10 miles above Yakima, will furnish electrical energy. The Yakima Valley Power Company is a holding company, organized for the construction of the high-tension line. Steam plants with an aggregate capacity of 3,000 hp are also being established, and these will be enlarged to duplicate the capacity of the water power. Substations will be established at Toppenish, Granger, Grandview, Mabton, Wapato, Kiona, Kennewick and Pasco. To carry the current across the Columbia River between Kennewick and Pasco a heavy three-strand cable, 3000 ft. in length, encased in lead, will be sunk to the bottom of the stream. The main line will be of aluminum wires on 50-ft. poles. The company will also carry its own private telephone line on the same poles. With the purchase of the electric lighting and water works plants at Kennewick and Pasco, the company acquired also a contract to furnish 1,000 hp to the Northern Pacific Irrigation Company, which has a 5,000-acre tract near Kennewick. As it is believed that requirements in the Yakima Valley will soon be greater than the present capacity of the plant, the company is having plans made for a large increase of its water power development.

ELECTRICAL COMPANIES BUYING TIN.—In the New York metal market it has been reported during the past week that there was a heavy demand coming from the electrical manufacturing companies for tin. This demand is said to be responsible for the advance in prices both in this country and Europe. The United States Steel Corporation is said to be buying tin in Singapore, and the market there has been advanced.

NEW WEST PENNSYLVANIA TRACTION COMPLETED.—The Pittsburg Railway Company, of the Philadelphia Company, has practically completed the building of the line to connect Pittsburg with the Washington & Cannonsburg Traction Company, which it recently purchased and will place it in operation in a few weeks. This line affords a through traction road to Washington, Pa.

THE NEBRASKA ELECTRIC COMPANY, jobbers, Omaha, has passed under new management, with the following officers: President, Paul W. Horbach; vice-president and treasurer, Albert G. Munro; secretary, Carl C. Wilson.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market during the week ended Oct. 31 was strong and dull. In other words, there were not a great many people who wanted to trade, but some showed a disposition to buy and very few speculators had the temerity to sell short. Those who are behind the market are not only well able financially to take care of all the stock that is afloat, but seem determined to maintain prices, and are not inclined to show much mercy to any luckless bear who attempts to interfere with prearranged plans. The last week before election is of course a week of more or less stagnation under any circumstances, and it was not unnatural that following the long period of depression this condition should have been accentuated. There was a general feeling of confidence in Wall Street that Taft would be elected, and this inspired hopefulness. Every one seemed to believe that prosperity was in sight, that a return to normal conditions was at hand. There was nothing in the way of news during the week which had any tendency toward discouragement. Europe is no longer an eager seller of American securities. The pressure has been relieved in the foreign exchanges by the more settled condition of affairs in the Balkans. It seems to be evident that no war will take place, and as money is about as plentiful and cheap on the other side of the ocean as in this country there is no desire to sell stocks that are better dividend payers than anything which can be bought in Europe. By far the most important and most encouraging feature of the week was the report of the United States Steel Corporation for the September quarter. The figures were considerably better than Wall Street had expected, and showed a vast improvement over the preceding quarter. The statement not only brought out anew the tremendous earning capacity of the corporation, but it showed what could be accomplished even in times of depression by the largest industrial company in the country. The total net earnings for the quarter were $27,106,274, as compared with $20,265,756 in the previous quarter. This is an increase of almost $7,000,000, and is the best quarter of the last year. The report showed that after making charges to depreciation and provision for sinking fund requirements and paying fixed charges, regular dividends on the preferred stock and 2 per cent on the common there was left over $5,152,023 to be added to surplus. These results were accomplished during operation of not more than 60 per cent of the normal capacity of the plants. The report explains the remarkable strength of the common stock of the corporation. Although there were some ups and downs to the market during the week the net changes were mostly advances, and new high records were made in many instances. The money market continued, as for months, with the supply plentiful and rates cheap. The demand for crop-moving purposes is practically over, and during the week under review there was a gain from the interior instead of a loss. Some banks in the middle West called in portions of their balances because some over-cautious depositors were alarmed by the arguments of political orators and demanded their money. This hoarding was only temporary, and was, of course, neither extensive nor sufficiently concentrated on one locality to amount to anything serious. On Oct. 31 call money was quoted at 1¼@1¾ per cent, and 90-day loans were made at 3 per cent. The figures in the table are of the close on that date.

NEW YORK.

	Oct. 26.	Oct. 31.	Shares sold.		Oct. 26.	Oct. 31.	Shares sold.
All.-Ch.	11⅝	11¾	4,400	Int.-Met., pfd.	29	29	4,670
All.-Ch., pfd.	37	39½	8,800	Mackay Cos.	73¼	73	1,200
Amal. Cop.	80¼	70¼	117,392	Mackay Cos., pfd.	20	69⅝	745
Am. D. T.	35*	35*	——	Manhattan Elev.	137½	137½	200
Am. Loc.	50	49¾	14,500	Met. St. Ry.	28*	24¼	30
Am. Loc., pfd.	105*	106½	695	N.Y.&N.J. Tel.	116	116½	210
Am. Tel. & Cble.	71	71*	——	Steel, com.	48	47½	246,059
Am. T. & T.	127	126⅞	5,200	Steel, pfd.	110½	110¾	20,335
B. R. T.	49¼	48¼	8,750	W. U. T.	60¼	59¼	1,150
Gen. Elec.	144	143	1,350	West'h, com.	82¾	82¼	10,400
Int.-Met., com.	9⅞	9⅞	3,250	West'h, pfd.	99½	100	500

PHILADELPHIA.

	Oct. 26.	Oct. 31.	Shares sold.		Oct. 26.	Oct. 31.	Shares sold.
Am. Rys.	44½	44½	——	Phila. Elec.	11*	11⅛	——
Elec. Co. of A.	9⅞*	9⅞*	——	Phila. R. T.	22¾	22½	——
Elec. Stor. B'ty	36¼*	35¼	——	Phila. Traction.	90*	89	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	51¾	51¼	——

CHICAGO.

	Oct. 26.	Oct. 31.	Shares sold.		Oct. 26.	Oct. 31.	Shares sold.
Chi. City Ry.	176*	176*	——	Chi. Tel. Co.	124	124*	——
Chi. Rys., Ser. 1.	104½*	104½	——	Met. El., com.	12¾*	12¾*	——
Chi. Rys., Ser. 2.	45	—	——	Nat'nal Carbon.	69*	69*	——
Com. Edison.	108¼	108¼	——	Nat. Carb., pfd.	110¼	111	——
Chi. Subway.	19½	20½	——				

BOSTON.

	Oct. 26.	Oct. 31.	Shares sold.		Oct. 26.	Oct. 31.	Shares sold.
Am. Tel. & Tel.	127	126¾	——	Mass. E. R., pfd.	51*	54*	——
Com'bind Tel.	122*	122*	——	Mex. Tel., pfd.	6*	6*	——
Gen. Elec.	145	144	——	N. E. Tel'p.	121	120	——
Edison El. Ill.	240	240	——	W. Tel. & Tel.	8*	8*	——
Mass. Elec. Ry.	10*	10*	——	W. T. & T., pfd.	75*	75*	——

*Last price quoted.
Shares sold are for week Oct. 26 to Oct. 31.

DIVIDENDS.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable Nov. 15.

Electric Properties Company, preferred and subscription receipts, quarterly, 1½ per cent, payable Nov. 10.

American Gas & Electric Company, preferred, quarterly, 1¼ per cent, payable Nov. 2.

Pressed Steel Car Company, preferred, quarterly, 1¾ per cent, payable Nov. 25.

United Wire & Supply Company, Providence, preferred, quarterly, 1¾ per cent, payable Nov. 2.

CHICAGO & MILWAUKEE ELECTRIC RAILWAY MUDDLE.—The report of Arthur Young & Company, accountants, appointed by Judge Grosscup, upon the affairs of A. C. Frost, promoter, and the bankrupt Chicago & Milwaukee Electric Railway Company, shows a very tangled state of affairs and the apparent misuse of one-half of the money paid into the enterprise. The report shows that $8,454,000, including the floating debt, have been spent in the construction of the entire road. Outstanding against this is a total bond and certificate issue of $16,000,000 and other debts, amounting to $2,169,000, making a total debt of $18,169,000. The difference between this amount and the money actually expended on the road is $9,815,000. Only a hazy idea of the ultimate disposition of this $9,815,000 exists outside of the circle of Frost and his confidants. Most of it went into the hands of A. C. Frost & Company, and thence was parceled out to various Frost enterprises. About $2,000,000 went to the Alaska Central Railway, of which Frost was president. A large amount was dissipated in the selling of bonds at extremely low prices. Until the affairs of A. C. Frost & Company are probed thoroughly the investors will not know all of the quicksands that sucked in their money. The Wisconsin division of the road is the most striking example of Frost financing. The actual cost was $2,225,000. Against this is a debt of $13,929,805, composed of these items: Bonds, $10,000,000; certificates, $1,000,000; debts, $2,169,000; uncompleted contracts $760,805. Another example is the construction of the road and terminal in the city of Milwaukee, which cost $199,000, but is saddled with a debt of $4,780,000.

CHICAGO TRACTION PARTNERSHIP PROSPEROUS.—It is estimated that the partnership between the city of Chicago on the one side and the Chicago City Railway Company and the Chicago Railways Company on the other is working out satisfactorily to all parties. Combining the income account for the two companies for the year 1907, it is found that the gross earnings were $18,775,768; expenses and taxes, $13,143,038; net from operation, $5,632,730. Deducting $2,802,167, the 5 per cent which is paid on the city's valuation of the capital invested, and there is left $2,830,563 of profits, which is divided: City's share, 55 per cent, $1,556,810; company's share, 45 per cent, $1,273,753. The share of the Chicago Railways Company alone in the final net profits was $720,905. The 5 per cent allowed by the city on the capital invested in its properties, before arriving at divisible profits, was $1,566,159, making its total income applicable to interest and dividends $2,287,064, which paid all fixed charges and left a surplus equal to 2 per cent on participation certificates, series 1. There is next the participation certificates series 2, and then series 3, which were exchanged for old Chicago Union Traction preferred stock.

PHILADELPHIA RAPID TRANSIT FINANCING SUCCEEDS.—At a special meeting Oct. 29 the stockholders of the Union Traction Company of Philadelphia voted to lend the Philadelphia Rapid Transit Company $9,000,000 of securities to be used as collateral for a $5,000,000 bond issue. The vote was 506,757 shares to 3,435. After the announcement that the loan proposition was carried the following resigned: John B. Parsons, as president and director; George D. Widener, as vice-president and director; P. A. B. Widener, W. H. Shelmerdine, George H. Earle and J. J. Sullivan, as directors. E. A. Ballard then nominated the following, who were elected to the vacancies: John H. Chestnut, William P. Katz, Jacob S. Disston, Henry Fernberger, Edward M. Story and J. J. Sullivan. After the Union Traction meeting the Philadelphia Traction Company stockholders held a special meeting ratifying the Union Traction $5,000,000 loan. The company has already sold to Drexel & Company $2,500,000 of the issue.

ATLANTIC CITY & SUBURBAN TRACTION SOLD.—At a foreclosure sale in Atlantic City, N. J., Oct. 31, the property of the Atlantic City & Suburban Traction Company was sold. The road was bought in by the first mortgage bond-holders for $91,000. A reorganization will be effected at once which, it is said, will eliminate the $250,000 second mortgage bonds, the $750,000 stock and provide for the company's back debts, amounting to between $125,000 and $150,000. The new company will be organized by the first mortgage bondholders with a capital consisting of $650,000 first mortgage 4 per cent bonds and $650,000 stock. The $500,000 5 per cent bonds of the old company will be exchanged for $500,000 of the new 4 per cent bonds. The remaining $150,000 of the new bonds will be sold to provide for new equipment and working capital. A bonus of common stock will be given to subscribers to the new bonds.

ASBESTOS PROPERTIES TAKEN OVER.—The asbestos properties in Canada controlled by Mr. Henry M. Whitney have been acquired by the British-Canadian Asbestos Company, which has been financed by Cramp, Mitchell & Sholeer. It is said that Philadelphia capital is represented in the transaction. The new company has $1,000,000 of bonds and $1,500,000 of stock. The Whitney properties were taken over on the basis that original stockholders received their money back and a bonus of 33 1-3 per cent in the stock of the new company upon which 8 per cent is now being earned.

SOUTHERN NEW ENGLAND TELEPHONE STOCK.—Vice-President Moran, of the Southern New England Telephone Company, says: "Southern New England telephone stock is now a settled 6 per cent security. The Bell Company is not buying a dollar's worth of the stock. That company owns about 33 per cent. In 1905 the stock made its high record of nearly $150 a share. The capitalization is $7,693,700. The directors have been authorized to issue new stock to bring it up to $10,000,000, but it is doubtful if any increase will be made this year."

CHICAGO TRACTION ASSESSMENTS INCREASED.—The Illinois Board of Equalization announces that the Chicago traction companies will be assessed materially more now that the value of the intangible properties is a known quantity. Stocks and bonds will be assessed on the basis of their market value. This would make assessed value of Chicago Railway Securities on the one-fifth method $6,676,538, or, deducting local assessment on "tangible" property, $4,173,489. Union Traction escaped the State assesment last year, having no charter.

CAMDEN & TRENTON TO BE REORGANIZED.—The general mortgage bondholders' committee and the first mortgage bondholders' committee of the Camden & Trenton Railway Company are working in harmony upon a plan of reorganization. Earnest efforts have been made to sell the property at private sale, but these have finally been abandoned. It was thought at one time that the Public Service Corporation of New Jersey would buy the property, but this expectation was not borne out.

TROUBLED TELEPHONE FINANCE.—An echo of troubled times in telephone finance is heard in the statement that at Trenton, N. J., last week Charles M. Myers and E. M. Colie, receivers of the Telephone, Telegraph & Cable Company of America, have filed in the Supreme Court the declaration in the suit against John Jacob Astor to recover $110,000. The receivers claim that Astor purchased a large block of stock and refused to pay assessments when due.

PLATTSBURG LIGHT, HEAT & POWER COMPANY BONDS.—The Public Service Commission of the Second District of New York has granted the application of the Plattsburg Light, Heat & Power Company for authority to dispose of an issue of $250,000 of bonds, recently authorized, at 85 instead of 90, as required in the original order. It was shown that the company was unable to dispose of the bonds at 90, but has found a market for them at 85.

MILWAUKEE ELECTRIC RAILWAY BONDS SOLD.—Spencer Trask & Company and N. W. Harris & Company have purchased jointly $1,000,000 Milwaukee Electric Railway & Light Company refunding 4½ per cent bonds, due 1931. These bonds are issued to refund a like amount of Milwaukee City Railway 5s, due Dec. 1, 1908. Bonds are offered at 95 and interest.

TELEPHONE BOND ISSUE RATIFIED.—The Chicago Telephone Company stockholders, at a special meeting, have unanimously ratified the $15,000,000 bond issue, $5,000,000 of which is taken by a syndicate of First Trust & Savings Bank, Merchants' Loan & Trust Company and Lee, Higginson & Company, of New York and Boston.

TO INCREASE CAPITAL OF WASHINGTON, BALTIMORE & ANNAPOLIS.—The stockholders of the Washington, Baltimore & Annapolis Electric Railway Company have voted to increase the capital stock of the company from $5,250,000 to $6,000,000.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings,	Charges.	Surplus.
Cape Breton (C. B.) Electric Company:					
August, 1908	$22,958	$11,886	$11,071	$4,053	$7,018
August, 1907	23,970	12,325	11,644	3,990	7,654
Lowell (Mass.) Electric Light Corp.:					
August, 1908	26,228	15,464	10,763	3,471	7,292
August, 1907	23,557	14,065	9,491	2,910	6,580
Minneapolis General Electric Company:					
August, 1908	74,411	34,414	39,997	32,091	7,906
August, 1907	67,715	34,880	32,835	26,653	6,181
Houghton County (Mich.) Electric Light Company:					
August, 1908	16,637	9,273	7,364	3,309	3,681
August, 1907	16,381	9,213	7,167	2,837	4,330
Edison Electric Illuminating Company, Brockton, Mass.:					
August, 1908	15,699	8,210	7,489	2,543	4,945
August, 1907	14,181	7,859	6,321	1,142	5,179
Pensacola (Fla.) Electric Company:					
August, 1908	19,562	13,141	6,420	4,488	1,933
August, 1907	21,044	12,620	8,425	4,073	4,355
Dallas (Tex.) Electric Corporation:					
August, 1908	94,739	63,553	31,186	28,329	2,856
August, 1907	94,294	63,451	30,843	27,070	3,772
Paducah (Ky.) Traction & Light Company:					
August, 1908	19,851	11,694	8,157	6,751	1,405
August, 1907	21,505	13,118	8,387	6,250	2,134
Puget Sound Electric Railway:					
August, 1908	166,594	103,844	62,750	42,928	19,822
August, 1907	165,079	97,693	67,386	38,705	28,682
Tampa (Fla.) Electric Company:					
August, 1908	45,474	29,723	15,751	4,388	11,363
August, 1907	45,022	34,468	10,554	1,587	8,967
Savannah (Ga.) Electric Company:					
August, 1908	51,544	30,858	20,686	15,835	4,851
August, 1907	54,417	34,799	19,618	15,250	4,369
Seattle Electric Company:					
August, 1908	382,742	219,660	163,082	94,834	68,248
August, 1907	365,531	204,671	160,861	83,901	76,959
Northern Texas Electric Company:					
August, 1908	92,503	53,530	38,973	17,434	21,549
August, 1907	97,930	55,097	42,833	13,830	29,003
Brockton & Plymouth (Mass.) Street Railway Company:					
August, 1908	16,515	9,275	7,240	2,213	5,027
August, 1907	17,327	9,079	8,248	2,411	5,837
Jacksonville (Fla.) Electric Company:					
August, 1908	36,271	19,142	17,129	8,252	8,877
August, 1907	34,695	20,095	14,600	6,949	7,651
Houghton County (Mich.) Street Railway Company:					
August, 1908	25,952	12,772	13,180	4,603	8,577
August, 1907	25,337	12,482	12,856	4,826	8,030
El Paso (Tex.) Electric Company:					
August, 1908	41,398	30,889	10,510	7,076	3,434
August, 1907	42,131	32,451	9,680	5,994	3,686
Whatcom County (Wash.) Railway & Light Company:					
August, 1908	29,417	17,268	12,149	7,976	4,173
August, 1907	31,696	16,686	15,010	7,710	7,299
Galveston-Houston (Tex.) Electric Company:					
August, 1908	101,708	55,101	46,607	20,527	26,080
August, 1907	99,467	52,898	46,569	19,280	27,289
Twin City Rapid Transit Company:					
September, 1908	583,876	276,588	307,288	138,667	168,621
September, 1907	561,446	251,276	310,170	115,142	195,028
Detroit United Railway Company:					
September, 1908	668,489	423,136	245,353	135,049	115,332
September, 1907	666,261	422,663	243,598	132,964	114,478
Northern Ohio Traction & Light Company:					
September, 1908	172,674	91,650	81,024	43,412	37,612
September, 1907	185,341	96,174	89,167	43,279	45,888
Toledo Railway & Light Company:					
September, 1908	222,891	111,899	110,992	71,976	39,077
September, 1907	208,684	119,520	89,164	68,819	21,255
Knoxville (Tenn.) Railway & Light Company:					
September, 1908	48,634	23,478	25,156	11,858	13,298
September, 1907	52,823	29,720	23,103	11,278	11,825
Nashville (Tenn.) Railway & Light Company:					
September, 1908	151,750	82,826	68,924	32,817	36,107
September, 1907	151,674	81,911	69,763	30,495	39,268
Norfolk & Portsmouth (Va.) Traction Company:					
September, 1908	162,938	94,834	68,104	.....	.....
September, 1907	295,610	161,920	133,690	.....	.....

GENERAL NEWS

Construction News.

ALBERTVILLE, ALA.—The Sand Mountain Electric Company has awarded the contract for machinery for its electric plant to the Wesco Supply Company, of St. Louis, Mo., the equipment of which includes two 80-hp boilers, one 125-hp engine and one 90-kw generator. M. A. Grover, of Birmingham, Ala., has charge of the construction if the plant.

AUBURN, ALA.—Plans are being considered by President Thach and the executive committee of the Board of Trustees for extending the transmission lines from the electric power plant of the Alabama Polytechnic Institute to furnish electricity to light the streets and residences of Auburn.

BERKELEY, CAL.—The San Francisco, Oakland & San Jose Railway Company has been granted a franchise to construct the Key Route Railway from the southern boundary to the northern boundary of the city.

CORONA, CAL.—The Corona Home Telephone Company has increased its capital stock from $25,000 to $50,000.

OCEAN PARK, CAL.—The Los Angeles-Pacific Railway Company has applied to the Trustees of Ocean Park for a franchise to construct and operate an electric railway on Lorelie Avenue.

VENICE, CAL.—Abbot Kinney, of Venice, is reported to be interested in a project to build an electric railway through Rialto to the Compton Road, thence through the Seagirt tract and back to Venice.

COLORADO SPRINGS, COL.—The Central Colorado Power Company is making arrangements to extend its transmission lines from Salina to Sugar Loaf to furnish electrical energy for operating a 150-ton cyanide mill, now under construction by the United States Gold Corporation. The company proposes to extend its system to all the mining districts of Boulder County to furnish electricity for lamps and motors for the mines and mills.

FAIRFIELD, CONN.—The Village Improvement Society has appointed a committee to make investigations in regard to establishing a street lighting system in the town. The members of the committee are G. S. Fox, G. W. Wakeman and E. W. S. Pickett.

HARTFORD, CONN.—The Board of Contract and Supply will receive proposals until Jan. 4, 1909, for public lighting in the city of Hartford in accordance with specifications on file at the office of the Board of Street Commissioners for a term of one and five years from June 1, 1909. James P. Berry is secretary.

MANCHESTER, CONN.—Plans are being made by the Glastonbury Light & Power Company to rebuild and improve its system in Manchester. The company has recently awarded a contract to the J. G. White Company, of New York, N. Y., for the construction of a substation. W. L. Ripley is local manager.

WILLIMANTIC, CONN.—Work has commenced on the construction of the new power plant of the Windham Manufacturing Company. The plant will be located at the No. 1 mill and will be equipped with electrical generating machinery. The mills will be made independent of the water supply.

WASHINGTON, D. C.—Bids will be received at the office of Superintendent of Prisons and Prisoners, Department of Justice, Washington, D. C., until Nov. 30 for furnishing and delivering at the United States Penitentiary, Atlanta, Ga., one 25-hp electric motor. Specifications with further information may be had upon application to the above office. R. V. Ladow is superintendent.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Nov. 21 for furnishing an electric push button coin lift, etc., in the U. S. Post Office, Court House and Custom House in St. Louis, Mo. Plans and specifications can be secured at the above office or at the office of the custodian, St. Louis, Mo. James Knox Taylor is supervising architect.

EAST POINT, GA.—The citizens have voted in favor of the proposition to issue $85,000 in bonds, the proceeds to be used for the construction of water works, sewerage and electric lighting systems. The cost of the electric light plant is estimated at $15,000.

LYONS, GA.—Owing to legal technicalities in connection with the bond election, the city will hold another election to vote on the issue of bonds for the construction of electric light plant and water works system. The contract for the construction of the plants was recently awarded to W. J. Edwards & Company, of Atlanta, Ga.

SANDPOINT, IDAHO.—Jerome L. Drumheller is reported to be interested in a project to develop the water power of Moyie Falls on Moyie River and transmit electrical energy to Sandpoint for manufacturing plants. It is stated that 8000 hp will be developed.

CHICAGO, ILL.—The town of Blue Island has entered into a contract with the Sanitary District of Chicago to furnish electrical energy for lamps and motors in the town. Compensation has been fixed on a basis of estimated returns to the district of $14,000 for the first year and increases each year thereafter. The Sanitary District is to take over the commercial lighting system and to supply electricity to residents at the rate of 10 cents per kw-hour. A contract for furnishing a plant to develop 5000 hp more has been awarded by the Sanitary District to S. Morgan Smith Company, of York, Pa., for $30,200.

ELKHART, IND.—The Board of Public Works has granted a franchise to the St. Joseph Valley Traction Company to construct and operate a street railway in the city.

WARSAW, IND.—The Commercial Telephone Company is making arrangements to erect a new copper circuit from Warsaw to South Bend through Plymouth.

MT. VERNON, IA.—The Mt. Vernon Electric Light Company has placed an order with the Allis-Chalmers Company, of Wilwaukee, Wis., for a new generator and engine.

WAVERLY, IA.—The contract for the construction of the power house for the electric light and power plant and water works system has been awarded to G. W. Clark, of Waverly, for $10,400.

WICHITA, KAN.—The Wichita Street Railway Company is planning to make extensions to its system.

COLLY, KY.—The Colly-Ola Telephone Company is making arrangements to construct a telephone line from Colly to Blair's Branch, a distance of four miles. John S. Webb, of Ola, Ky., is manager.

GLASGOW, KY.—Negotiations are now under way between local capitalists and the Ohio Valley Construction Company for the construction of an electric railway from Hodgenville to Glasgow by the way of Columbia.

HINDMAN, KY.—The Hindman Telephone Company is making plans to erect another telephone line from Hindman to Jackson, a distance of 40 miles. W. H. Dranghan, of Hindman, is manager.

LONDON, KY.—Plans are being considered by the Camp Ground Telephone Company to erect an additional circuit from London to Lily. J. T. Wilson, of London, is manager.

PIKEVILLE, KY.—The Eastern Kentucky Home Telephone Company is constructing a telephone line from Pikeville to Baker, a distance of 40 miles, connecting with the Letcher County Home Telephone Company's lines to Whitesburg. The company is also making arrangements to construct a local telephone line from Vergie via Beatrice and Donton to Jewell, Ky., 24 miles in length.

PINE TOP, KY.—Arrangements are being made by the Carr's Fork Telephone Company to construct a telephone line from Pine Top to Bath and Dirk. S. R. Blair, of Pine Top, is manager.

NEW ORLEANS, LA.—The Hotel Grunewald Company has been granted permission by the City Council to construct and operate an electric light, heat and power plant.

BETHEL, MAINE.—The N. R. Springer Company, it is reported, contemplates installing an electric plant in connection with his woodworking mill, and will furnish electricity in the village of Bethel.

BALTIMORE, MD.—The Washington, Baltimore & Annapolis Electric Railway Company contemplates the installation of additional electrcial equipment in its power plant.

BREATHEDSVILLE, MD.—The Antietam Electric Light & Power Company is planning to develop water power at a cost of about $15,000. It is estimated that 200 hp can be obtained, which will be transmitted by electricity to Boonsboro and other cities. The equipment will include a 75-kw Western Electric generator and two 39-in. turbines, manufactured by the S. Morgan Smith Company, of York, Pa. O. E. Shifler is engineer in charge.

POOLESVILLE, MD.—The Montgomery Telephone Company, recently incorporated, has purchased the telephone system in Montgomery, Frederick and Carroll Counties from the American Telephone Company. The company proposes to construct an independent metallic circuit.

BERLIN, MASS.—The Board of Aldermen has granted the Marlboro Electric Company permission to construct a transmission line to Berlin.

HOLDEN, MASS.—The Marlboro Electric Light Company, of Marlboro, Mass., has submitted another proposition to the electric light committee, offering to furnish 79 incandescent street lamps for $13.50 per lamp per year.

NORTH BROOKFIELD, MASS.—The Oxford Linen Mills are negotiating with Theodore Bates, of East Brookfield, with a view of utilizing the water power at East Brookfield to generate electricity, and transmit it to North Brookfield to light and operate the Oxford Linen Mills.

TYNGSBORO, MASS.—The Lowell Electric Light Corporation is contemplating extending its lines to Tyngsboro to furnish electricity to light the streets and residences of the town.

WEST BOYLSTON, MASS.—The citizens are considering the question of lighting the streets and residences of the town by electricity. The Worcester Electric Light Company will furnish the town with an estimate of the cost of the service.

DETROIT, MICH.—The Windsor, Tunnel & Lake Erie Electric Railway Company has applied to the City Council for a franchise to operate its proposed railway in this city.

EAST LANSING, MICH.—Plans are being made for the construction of a water works and sewerage system, for which bonds to the amount of $10,000 have been issued. It is proposed to operate the pumps by electricity, although plans as yet have not been fully decided upon.

TRENTON, MICH.—The Interstate Telephone Company has been granted a franchise to erect a telephone exchange and lines in this village.

DETROIT, MINN.—The Detroit Telephone Company is planning to extend its telephone line to Killarney Beach on Pelican Lake next spring, and also to make extensive improvements to its system in this city. The company is now erecting an extension of its system to the Shoreham line, which will extend along the west side at Lake Melissa to Bucks Mills.

GULFPORT, MISS.—Arrangements are being made by the Gulfport & Mississippi Coast Traction Company to extend its railway from Gulfport to Pass Christian. J. A. Jones is general manager.

SEMINARY, MISS.—The Meridian Home Telephone Company is contemplating taking over the telephone plant at Seminary and constructing a toll line from Hattiesburg to Seminary, a distance of 32 miles. The company also contemplates extending a line through to Mt. Olive, 17 miles in length.

ELSBERRY, MO.—Bids will be received by the City Clerk until Nov. 12 for furnishing material and construction of a municipal electric light plant, including horizontal tubular boilers, high-speed direct-connected engine, heaters, boiler feed pumps, steam piping, alternating-current generator, direct connected, switchboard, incandescent street lighting apparatus, pole line, transformers, etc., and the construction of a brick power house. Plans and specifications are on file at the office of the City Clerk and at the office of W. A. Fuller, Chemical Building, St. Louis, Mo., engineer.

KANSAS CITY, MO.—The County Commissioners of Wyandotte County have granted a franchise to the Kansas City & Olathe Electric Railway Company to extend its railway from the present terminus in Rosedale to Kansas City, Kan.

BILLINGS, MONT.—Surveys are now being made for the proposed electric railway of the Yellowstone Valley Traction Company from Billings to Laurel. The company proposes to build a street railway in Billings and an interurban railway to Laurel. Norman S. Poole is interested in the enterprise.

ROUNDUP, MONT.—The Roundup Coal Mining Company has submitted a proposition to the town officials to furnish electricity in Roundup for lamps and motors.

PAPILLION, NEB.—Plans are being prepared by R. H. Oliver, of Omaha, Neb., engineer, for the construction of a power house for the Nebraska Light & Power Company.

WALTHILL, NEB.—The Village Board is considering the question of establishing a combined water works system and electric light plant, for which estimates will be called in the near future.

WOOD RIVER, NEB.—F. K. Wheeler has been awarded a contract for the construction of an electric light plant and water works system for $19,550.

GOLDFIELD, NEV.—Plans are now being perfected for the construction of the proposed new power plant of the Nevada-California Power Company. The company expects to be ready to receive bids for the construction of the plant about Feb. 1, 1909, which will include the construction of a new power house and dams, the laying of about two miles of wood-stave pipe, 3000 to 4000 ft. of steel pipe, and purchase of two or three 1500 to 2000 generators, with water turbines, transformers and other necessary equipment.

PORTALES, N. M.—F. J. Molinari, of Portales, writes that there is a good opening for the installation of an electric light plant in that town, which has a population of about 2800.

BUFFALO, N. Y.—The Board of Supervisors has awarded a contract to the DuBois Iron Works, of DuBois, Pa., at $6,762 to install a gas engine in the Seventy-fourth Regiment Armory in connection with the electric light plant.

GENEVA, N. Y.—The Geneva-Seneca Electric Company has commenced work on the construction of its new power house here. The company proposes to expend about $150,000, of which $75,000 will be utilized for the power house and equipment and the remainder upon its transmission system. Contracts have been placed with the General Electric Company for the electrical machinery, including a Curtis steam turbo-generator set. Babcock-Wilcox water tube boilers will be installed; the condensers will be furnished by the Henry R. Worthington Company, of New York, N. Y. The new plant will have an output of 1000 hp and will furnish electrical energy in Waterloo and Seneca Falls, as well as Geneva. The old station will be kept intact for the present to use for supplementary and emergency purposes.

LESTERSHIRE, N. Y.—Arrangements are being made by the Faatz-Reynolds Felting Company to operate its plant by electricity instead of steam power. The plans call for the installation of two engines and generators in the power house. Electrical energy will be used in the present plant as well as in the new addition now under construction.

ONEIDA, N. Y.—The Oneida Railway Company has petitioned the City Council for a franchise to construct an electric railway from the main road at Sherrill to Kenwood.

SYRACUSE, N. Y.—The Syracuse Lighting Company is installing a new street lighting system. The system will include about 1500 lamps. Electricity for operating the system will be transmitted from Niagara Falls.

SYRACUSE, N. Y.—Bids will be received by Frank X. Wood, purchasing agent of the Onondaga County Home, Court House, Syracuse, N. Y., until Nov. 5, for the installation of a complete power plant at the Home. Specifications for the plant can be secured at the office of Archimedes Russell and Melvin L. King, architects, Snow Building, Syracuse, N. Y.

BARIUM SPRINGS, N. C.—Plans are being considered by the Presbyterian Orphans' Home to install an electric light plant. Rev. John Wakefield is superintendent.

CAMERON, N. C.—The Regal Hosiery Mills Company, recently incorporated, will install an electric light and power plant in connection with its mills. Charles C. Jones, R. D. Jones and others are interested in the enterprise.

HENDERSONVILLE, N. C.—Arrangements are being made by George Stephens, of Charlotte, N. C., for the installation of an electric power plant at Kanuga Lake County Club, near Hendersonville, to furnish electricity for lamps to the community and for operating a small woodworking plant.

MANCHESTER, N. C.—The Little River Power & Transmission Company, recently incorporated, has awarded a contract to Thomas B. Whitted Company, of Charlotte, N. C., for the construction and equipment of its power plant. The Little River Power & Transmission Company has a franchise to furnish electricity for lamps in Manchester and will operate a street railway system in Fayetteville, N. C.

VADE MECUM, N. C.—H. P. McKnight, lessee of the Vade Mecum Springs, writes that the cost of the proposed electric power plant to be erected at Vade Mecum will be about $650,000. Bids for the construction will probably be received about Dec. 1, 1908.

FARGO, N. D.—Arrangements are being made to organize a telephone company for the purpose of installing a telephone system to connect the townships of Reed and Raymond with Fargo.

HAMILTON, N. D.—The Citizens' Telephone Company is planning to construct a telephone line to the Fleming District.

BUCYRUS, OHIO.—Bids will be received by the city of Bucyrus, Ohio, until Nov. 20, for the purchase of $84,000 electric light bonds, the proceeds to be used for the construction of a municipal electric light plant.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has recently purchased a site on which it proposes to erect a large power plant, work on which may begin next spring.

LORAIN, OHIO.—The City Council is considering the question of establishing a municipal electric light plant, and has engaged F. C. Work, electrical engineer, to prepare plans and estimates for same.

MINERVA, OHIO.—The Erie City Iron Works, Erie, Pa., has been awarded a contract by the Board of Public Service to install a 150-hp boiler in the municipal electric light plant for $1,269. L. E. Weber is secretary.

WARREN, OHIO.—Mayor W. B. Kilpatrick has vetoed the franchises granted to both the Hydro-Electric Company and the Warren Light & Power Company, giving as his reason that the people of the city are not properly protected.

FT. GIBSON, OKLA.—The electric light plant at the State School for the Blind, at Fort Gibson, was recently destroyed by fire. George W. Bruce is president.

WILZETTA, OKLA.—The capital stock of the Wilzetta Farmers' Telephone Company has been increased from $1,500 to $7,500.

ASHLAND, ORE.—Plans are being made to construct a telephone line from Ashland to the summit of Ashland Butte by the Forest Service. It will be about 12 miles in length.

CHESTER, PA.—Joseph Shortledge, of Concordville, Pa., is reported to be promoting the construction of an electric railway from Chester to Llewellyn, Concordville and West Chester.

JOHNSTOWN, PA.—Arrangements are being made by the Johnstown Telephone Company for making improvements to its lines, which will include replacing the present wires with cables. The cost of the work is estimated at $50,000.

KRUMSVILLE, PA.—The erection of a new telephone line from Krumsville to Hamburg is contemplated by the Kutztown Rural Telephone & Telegraph Company.

MIFFLINBURG, PA.—The installation of an auxiliary steam plant in the municipal electric light station is under consideration by the Town Council.

MOUNT AETNA, PA.—Arrangements are being made to form a company to build a telephone line of about 20 miles between Mt. Aetna and Frystown. The company will be known as the Mt. Zion Company.

PHILADELPHIA, PA.—Arrangements are being made for the construction of the new buildings for the Curtis Publishing Company, including a large power house, on Sansom Street. It is understood that work will begin early in December.

PITTSBURG, PA.—Plans are being considered for converting the old River Avenue pumping station into a power house for the municipal electric light plant.

PITTSBURG, PA.—Plans have been prepared by the Universal Cement Company, a subsidiary of the United States Steel Corporation, to double the output of its slag cement plant at Universal, Pa., at a cost of about $2,000,000. The plant is operated throughout by electricity, furnished by the Homestead plant of the Carnegie Steel Company.

PITTSBURG, PA.—Bids will be received until Nov. 23 by the City Comptroller for furnishing and installing equipment in connection with the extension of the filtration works, being Contract 11, as follows: "A," electrical equipment, consisting of power and lighting circuits in 10 filter beds and one gallery, with the necessary appurtenances; "E," 10 sets of indicator and recording apparatus; "F," ventilating and heating apparatus, consisting of motor-driven fans, steam coils, etc. George W. Guthrie is mayor.

BRISTOL, R. I.—Arrangements are being made to transfer the stock of the Bristol County Gas & Electric Company to the Narragansett Electric Lighting Company, of Providence. Plans are being made to abandon the local plant and to furnish electricity from the plant of the Narragansett Electric Lighting Company at Providence.

ROCK HILL, S. C.—It is stated that the Carolina Water, Light & Power Company, successor to the Rock Hill Light & Power Company, is planning to expend $25,000 for new pumps, etc., contract for which has been awarded to the Sydnor Well Pump Company, Richmond, Va. The company is allowed 60 days in which to complete the work; in case of failure, it is said, the town of Rock Hill will revoke the franchise and take over the plants, to be operated by the municipality. P. A. Wilcox is receiver for the company.

SPARTANBURG, S. C.—The Carolina, Clinchfield & Ohio Railroad Company is planning to install a telephone system between Spartanburg and Bostwick, N. C., which will be used during the construction of the railroad. M. J. Caples is chief engineer.

HERRICK, S. D.—The Gregory County Telephone Company, which is now constructing a telephone line from St. Charles to Herrick, is planning to erect a telephone line from Burke to Herrick in the near future.

LEMMON, S. D.—The town officials have granted the Montana-Dakota Telephone Company a franchise to maintain a long-distance telephone system and exchange in this town.

VIENNA, S. D.—Application has been made by Mr. Morrison to the Town Council for a franchise to install an electric light plant.

AUSTIN, TEX.—It is reported that the Board of Regents will apply to the Legislature for an appropriation to provide for the construction of a fireproof library building and power plant.

CORSICANA, TEX.—Arrangements are being made by the Corsicana-Palestine Interurban Railway Company to construct an interurban railway between Corsicana and Palestine, Tex., a distance of 60 miles. Contracts for the work will be awarded after Jan. 1, 1909. J. V. Watkins is president.

DALLAS, TEX.—Application has been made by E. A. Worden and D. M. Joens for a franchise to construct and operate an electric light, heat and power plant in this city.

FT. SAM HOUSTON, TEX.—Bids will be received at the office of the constructing quartermaster until Dec. 2 for the construction of an extension to the transmission lines of the electric lighting system at Ft. Sam Houston and additional street lamps. Plans and specifications may be seen at the above office. L. J. Fleming is constructing quartermaster.

GROVETON, TEX.—The capital stock of the Groveton Light & Ice Company has been increased from $15,000 to $20,000.

McKINNEY, TEX.—Plans are being made to extend the municipal electric lighting system.

CHESTER, VT.—The Chester Water & Light Company has entered into a contract with the Claremont Power Company for electrical energy to operate its system. Electricity will be supplied from the Cavendish plant. The company expects to have the new system in operation by Jan. 1, 1909, when a day power service will be established.

BEDFORD CITY, VA.—A proposition has been submitted to the City Council for the construction of an electric power plant, which calls for the organization of a company with a capital stock of $65,000. It is proposed to acquire a dam site on the James River and transmit electricity to Bedford City, a distance of about 25 miles. The proposed plant will have an output of about 1000 hp.

LYNCHBURG, VA.—The United Cigarette Machine Company is planning extensive improvements to its power house to supply electricity for operating its new plant, which is nearly completed. The company recently placed an order with the Foos Gas Engine Company, of Springfield, Ohio, for a 100-hp multiple-cylinder vertical engine and producer gas plant. The engine will be direct connected to a General Electric generator.

BELLINGHAM, WASH.—The E. K. Wood Lumber Company is planning to install electric motors to operate its plant. It is proposed to abandon steam power in the planing mills and operate that department of the mills by electricity.

BELLINGHAM, WASH.—Plans are being made by the Nooksack Valley Traction Company for the construction of its proposed railway from Bellingham to Blaine, and from Bellingham to Sumas, Ferndale and Lynden, for which contracts for construction will be awarded in about 90 days. The road when completed will be about 60 miles in length.

CASHMERE, WASH.—The power plant of the Valley Power Company is nearly completed. The plant is located on the Wenatchee River, five miles above Cashmere, and has an output of 300 hp, with provisions to increase it to 1000 hp. The plant will furnish electricity for operating pumps for irrigation purposes. The company has placed a contract to supply electrical energy to operate the municipal electric light plant and water works system at Cashmere. The transmission lines have been completed as far as Cashmere, and will be extended further down the valley through Wenatchee. The equipment of the plant consists of a Morgan and Smith turbine, operating under a 60-ft. head, direct connected to an Allis-Chalmers 6000-volt, three-phase, 60-cycle generator. Energy is now transmitted at 6600 volts, but as soon as extensions to the transmission lines are completed the voltage will be raised to 15,000. The officers of the company are: F. M. Scheble, president; W. T. Clarke, vice-president, and Marvin Chase, secretary and treasurer.

EPHRATA, WASH.—O. A. Kuck has been granted a franchise by the County Board to construct an electric railway connecting Adrian, Ephrata and the Soap Lake health resort.

HUSUM, WASH.—Preparations are being made by Martin & J. T. Thompson to install an electric power plant, the cost of which is estimated at $10,000. Contracts for machinery have not yet been placed.

SPOKANE, WASH.—The Spokane, Columbia & Western Railway Company is planning to construct a railway from Spokane to the mouth of the Spokane River via Davenport and Peach, on the Columbia River, about 70 miles in length, for which surveys have already been made. Clyde M. Graves is president, and Alexander M. Lupfer is chief engineer, both of Spokane.

KEYSTONE, W. VA.—The Keystone Light & Power Company has made application for a franchise to construct an electric railway to Switchbach and to Kimball, a distance of 16 miles.

MARTINSBURG, W. VA.—Plans are being considered to purchase the Round Top cement plant at Hancock, to be equipped for an electric power plant.

MILWAUKEE, WIS.—The Milwaukee Light, Heat & Traction Company has been granted a franchise to construct a branch railway from Waterford to Lake Geneva. John I. Beggs is president and general manager.

OMRO, WIS.—Plans are being made by the Winnebago Traction Company, which is owned and controlled by the Wisconsin Electric Company, to extend its railway from Omro to Berlin, a distance of about 13 miles.

REEDSBURG, WIS.—The City Council is considering the question of establishing a day power service in connection with the municipal electric plant. About $8,000 will be required to equip the plant to furnish the proposed service.

WENTWORTH, N. S., CAN.—The County Council has granted the Wentworth Home Telephone Company a franchise to erect about 35 miles of telephone lines in Wentworth County.

COBURG, ONT., CAN.—The Town Council has decided to enter into a new contract with the Coburg Water & Electric Company to supply the town with water, and electricity for lighting the streets. Under the new contract the company is to furnish arc lamps at a reduction of $10 per lamp per year with an all-night service, instead of 12 o'clock as under the present contract. The price of incandescent lamps has been reduced 25 per cent. The rate for electricity for lighting private residences has been reduced 33 1/3 per cent. The town is given the privilege to purchase the plant at any time.

CHIHUAHUA, MEX.—The Intermountain & Mining Telephone Company is preparing to build telephone lines from Casa Grandes, connecting all of the principal mines within a radius of 100 miles of Casa Grandes; also to construct a long-distance telephone line to El Paso, Tex., a distance of about 165 miles. The construction of another line from Guaronapeta to Madeira is under consideration. This will connect with the long-distance telephone system owned and operated by an American syndicate, which has established a large lumber business in the mountains in that part of the State. The proposed plans call for the erection of more than 500 miles of lines.

New Industrial Companies.

THE PHOENIX GAS ENGINE COMPANY, of St. Louis, Mo., has been incorporated by R. S. Kingsland, George T. Dougherty, Charles E. Clore and M. Gill.

THE EDWIN C. LEWIS COMPANY, of Boston, Mass., has been chartered with a capital stock of $75,000 to manufacture and deal in electrical apparatus, etc. E. C. Lewis, of Boston, Mass., president and treasurer.

PUTNAM & HARO, INC., has been chartered to carry on a general engineering, construction and contracting work. The incorporators are John R. Putnam, Wentworth G. Haro and Michael R. Mattee, all of New York, N. Y.

THE RANDALL ELECTRIC WELDING COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $20,000, by Harry C. Randall and Guy Osborn, of New York, N. Y., and William Corrigan, of Mt. Vernon, N. Y.

THE UNITED ELECTRIC & HARDWARE COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $1,000,000 and the following directors: A. W. Brode, L. D. Brode, A. B. Cass, A. R. Fierce and J. H. Lowe.

H. A. STEVENS, INC., has been incorporated, with a capital stock of $20,000, by Howard A. Stevens, Fred L. Niblo, of New York, N. Y., and George Wainwright, of Jersey City, N. J. The company proposes to manufacture lighting fixtures.

THE BEAKEMAN-BLACK ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State at Dover, Del. The incorporators are F. E. Beakeman, G. H. Black, C. E. Hamilton, L. E. Seas and R. A. Marshall, all of St. Louis, Mo.

THE EMPIRE TALKING MACHINE COMPANY, of New York, N. Y., has been chartered, with a capital stock of $1,200,000, by J. Noll, W. T. Jenkins and S. W. Slayden, all of New York, N. Y. The company proposes to manufacture sound-producing machines.

THE CAPITAL ELECTRIC ADVERTISING COMPANY, of Albany, N. Y., has been chartered, with a capital stock of $5,000, and the following directors: Morton H. Havens, Jr., and Robert E. Whalen, of Albany, N. Y., and Henry P. Kernochan, of Syracuse, N. Y.

THE CANADIAN ENSIGN COMPANY, of Portland, Maine, has been organized with a capital stock of $150,000 for the purpose of manufacturing and dealing in the Ensign electric calculating machine. The officers of the company are: Emory S. Ensign, of Brookline, Mass., president, and Fred R. Hardenbergh, of Boston, Mass., treasurer.

THE PITTSBURG HIGH-VOLTAGE INSULATOR COMPANY, of Pittsburg, Pa., has been chartered, with a capital stock of $60,000, and the following directors: C. M. Semler, of Hamilton, Ohio, treasurer; George F. Young, Zanesville, Ohio, and William C. Weaver, Pittsburg, Pa.

THE ASTORIA METAL WORKING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $25,000, for the purpose of manufacturing machinery, engines, boilers, etc. The incorporators are A. S. Houghton, W. A. Shepard and C. B. Young, all of New York, N. Y.

THE FAIRMOUNT ELECTRIC & MANUFACTURING COMPANY, of Philadelphia, has reorganized and incorporated, with a capital stock of $50,000. It will manufacture electrical and mechanical specialties and devices. The following officers have been elected: Mr. J. C. Vogel, president; Mr. Geo. W. Slack, secretary, and Mr. Chester S. Leonard, treasurer.

New Incorporations.

MONTGOMERY, ALA.—The Choctawhatchie River Light & Power Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000,000 and proposes to construct a dam across the Choctawhatchie River for the development of water power. The incorporators are: W. C. Fritter, Morris Lumber Company; A. C. Kelly, W. H. Clark, G. W. L. Smith and A. J. Smith.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed with the Secretary of State for the Mojave Water & Power Company. The company is capitalized at $20,000,000, and the directors are: Julien Mathieu, Harry C. Mack, C. F. Metter, of Oakland, Cal.; F. C. Van Deinse and C. S. Goodrich, of San Francisco, Cal.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago & Proviso Railway Company by F. D. Kilmer, J. M. Swanson, H. L. Fearing, M. A. Rawson and N. C. Fisher.

GREENSBURG, KY.—Articles of incorporation have been filed for the Greensburg & Miami Telephone Company by J. L. Booker, C. R. Cabell, J. T. Mercer and others.

DOWAGIAC, MICH.—The Dowagiac Railway Company has filed articles of incorporation, with a capital stock of $200,000. The incorporators are: C. K. Minary, H. S. Grey and Henry C. Mason, of Benton Harbor, Mich. The company proposes to extend the electric railway from Eau Claire to Dowagiac.

SPRINGFIELD, MO.—The Niangua & Western Railway Company has been incorporated, with a capital stock of $600,000, by George Lovan, S. L. O. Lovan, A. B. Lovan and J. N. Smith, all of Springfield, Mo. The railway will be 60 miles in length and is to be built on private right of way.

NEW YORK, N. Y.—The Beacon Light Company has been incorporated, with a capital stock of $10,000, by Joseph Aninsman, Max Bernstein and Isadore Babuskin, of New York, N. Y.

FREMONT, N. C.—The Fremont Telephone Company has been incorporated, with a capital stock of $10,000, by M. T. Johnson and others.

LAWTON, N. D.—The Lawton Telephone Company has been chartered, with a capital stock of $15,000, by J. A. Aird, Oliver Davidson, Charles G. Kope and others.

ZANESVILLE, OHIO.—The Ohio Electric Company has been organized to construct an electric interurban railway from Zanesville to Bellaire, on the Ohio River, where it will connect with the Wheeling Traction Company. An option has been secured by the company on the property of the Cambridge Light, Power & Traction Company. W. E. Gibbs, general manager of the Zanesville Electric Company, and S. A. Weller, both of Zanesville, are interested in the enterprise.

HOLLIS, OKLA.—Articles of incorporation have been filed for the Hollis Telephone Company, with a capital stock of $2,000, by J. T. and D. Stevenson and J. B. Hacker.

KANSAS, OKLA.—The Northeast Oklahoma Telephone Company has been incorporated, with a capital stock of $2,000, by D. L. Bird, C. L. and D. H. Pratt.

MEHAN, OKLA.—The Mehan Telephone Company has been incorporated, with a capital stock of $2,000, by W. D. Williams, D. C. Franklin, William Vailey and others.

EUGENE, ORE.—The McKenzie River Power & Railway Company has been chartered to build an electric railway from Eugene to Belknap and Foley Springs. The company is capitalized at $1,000,000, and the incorporators are: George Sengstake, G. A. Lyman and Zera Snow.

LEMMON, S. D.—The Dakota Southern Railway Company has filed articles of incorporation with the Secretary of State, with a capital stock of $90,000.

LIMESTONE, TENN.—The Limestone Telephone Company has been incorporated, with a capital stock of $3,000, by S. B. Morelock, J. J. Marshall, B. F. Broyles, W. S. Keehler, J. G. Bright and John Barkley.

RIPLEY, TENN.—The Mack Telephone Company has been chartered by J. A. Hutcheson, J. E. Pierson, D. N. Glenn and others.

CUERO, TEX.—Articles of incorporation have been filed for the Cuero Light & Power Company, with a capital stock of $100,000, by O. T. McAllister, of Cuero; W. M. Ratcliffe, of Brownsville, Tex., and Daniel J. Hayes, of Houston, Tex.

PARADISE, W. VA.—The Paradise & Raymond City Telephone Company has been chartered, with a capital stock of $20,000, by L. O. Landen, of Sigman; M. R. Sigman, J. A. Hammack, Alfred Meadows and J. W. Foster, all of Paradise.

LA CROSSE, WIS.—The Barre Mills Co-Operative Telephone Company has been organized to construct a telephone line. Edwin Engebretson is secretary.

MADISON, WIS.—The Horseshoe Telephone Company, of Kewaunee County, has filed articles of incorporation with the Secretary of State. The company is capitalized at $4,000, and the incorporators are Louis E. Erickson, Julius Kolder, George Erickson and others.

Legal.

ELECTRIC COMPANY NOT LIABLE WHERE INJURED PARTY IS GUILTY OF CONTRIBUTORY NEGLIGENCE.—Though electric companies are held by the law to a high standard of care in regard to the appliances which they use, they are not liable in damages where a person is injured through his own fault. Any negligence on the part of the person injured that contributes to, or is the proximate cause of, the injury defeats his right of action. Under this rule, the plaintiff in a recent Pennsylvania case, suing for the death of her husband, was held not to be entitled to damages from the defendant electric light company. The company had extended two wires from the top of a pole to a transformer which was fastened to the side of a tankhouse that was on the top of a dwelling. The insulation had become weatherworn and frayed, and in places hung in shreds from the wire, and at one place at a bend in the wire near the transformer an inch of wire was bare. How long this inch of wire had been bare was not shown. The defendant employed no one whose special duty it was to inspect the wires, but it was the duty of the linemen, who read the meters monthly and installed meters and transformers and made ordinary repairs, to observe the wires and to repair or report any defects. The bare wire could be safely handled by a person standing on a dry board or box, and had been handled with bare hands by the plaintiff's witness. The plaintiff's husband, James Wier, was a journeyman painter, and with two other men, McAfee, a journeyman, and Keegan, a foreman in charge of the work, was engaged in painting the outside wood and brickwork of the dwelling. They first worked on the top of the tankhouse, and while there they observed the wires below, and one of them remarked that "it looked like a rag show." Before they went on the roof of the dwelling house, Keegan told Wier to be careful of the wires. When they came up a ladder to this roof to work, Wier read the name of the maker and the capacity of the transformer, and remarked: "It isn't the watts that would fix you. It is the electricity that is in it." What then took place is thus described by the plaintiff's only witness to the occurrence: "Then he went on painting. Mr. Wier was coming down the end of the weather boarding along the mansard roof. Mr. Keegan went to work in the corner, and reached his part off the stepladder. Mr. Wier was painting from the bottom up on the brickwork. He got up to the bottom of the transformer. Mr. Keegan told him to wait for the stepladder, that he could reach it off the stepladder over the transformer where there would be no danger. The consequence was he reached between the wires, and was struck at the point connecting the wires with the transformer." When shocked, he fell from the roof of the dwelling to the roof of a porch below, and from there to the ground. Whether his death was caused by the shock or the fall, which broke his neck, was unknown. The circumstances shown, it was held, constituted contributory negligence on the part of Wier and the company was exonerated of all liability. Wier vs. Haverford Electric Light Company, Supreme Court of Pennsylvania, 70 Atl. Rep. 874.

Personal.

MR. VAL. A. FYNN, the electrical engineer of London, England, is in this country for the purpose of visiting the works of the large electrical manufacturing companies.

MR. J. M. WAKEMAN, vice-president of the McGraw Publishing Company, is now on the Continent of Europe, with Mrs. Wakeman, and will return about the middle of December.

MR. C. C. COPPIN, until recently connected with the Panama Canal work at Culebra, Panama, has accepted an executive position in the drafting department of the Allis-Chalmers Company, Milwaukee.

MR. E. W. GOLDSCHMIDT, New York manager of the Wagner Electric Manufacturing Company, will sail on Friday of this week, Nov. 6, on the White Star liner *Cretic* for Naples, expecting to remain on the other side until the first of the year.

MR. JOHN F. HAYFORD, member of the International Boundary Commission of the United States and Mexico, a well-known engineer and a graduate of Cornell ('89), has been appointed dean of the Northwestern University Engineering School, at Evanston, Ill., now being organized. Dean Hayford will take up his duties Sept. 1, 1909.

PROF. E. J. HOUSTON, who is a prolific writer on electro-technics, has just brought out through Frederick A. Stokes Company, of New York, "The Wonder Book of Magnetism," which deals with the principles and applications of magnetism and traces the evolution of modern electrical developments. It is written clearly and, while "popular," is well done and thoroughly instructive.

MR. W. G. BROWN has resigned as vice-president and general manager of the Ewing-Merkle Electric Company, of St. Louis, to accept a position with the Continuous Rail & Safety Switch Company, which has just placed on the market a patented frog and switch that will be to railroad track construction, it is claimed, what the air-brake and safety coupler are to trains.

MR. VAN RENSSELAER LANSINGH, illuminating engineer, of New York, recently delivered an address before the electrical section of the Canadian Civil Engineers' Society, Montreal, on Oct. 22. The talk emphasized the necessity of engineers and architects working together to secure proper natural and artificial lighting of buildings. A somewhat similar address was delivered before the Dayton Electrical Club, of Dayton, Ohio, on Nov. 5. The membership of the Dayton Electrical Club not alone embraces representatives and engineers of the Dayton Lighting Company, but all of the local electrical contractors and jobbers, as well as a considerable number of large building owners and managers.

MR. P. P. CALVO, one of the chief mining and electrical engineers of Colombia, South America, has recently arrived in this country, and expects to spend some time here and, possibly, in Europe. Mr. Calvo, who is a resident of Bogota, is well informed as to all the latest developments, particularly in electrochemistry, and has taken an active part in the adoption of electrical methods and apparatus in his native country. Bereavement and ill health have compelled him to seek rest and recreation, and his present trip may last some months. Colombia has felt the business depression of the last year or two, but with her new railroad to Bogota and her wonderful resources of all kinds, has a future in store of great prosperity. Mr. Calvo is heavily interested in coal properties in the Republic.

MR. E. W. RICE, JR., delivered a very interesting address on October 29 before the Schenectady section of the American Institute of Electrical Engineers, embodying some reminiscences of pioneer work within the General Electrical Company. As a close associate of Prof. Elihu Thomson, he was able to give a great deal of valuable data as to the creating and upbuilding of the old Thomson-Houston interests. He mentinoed that Prof. Thomson had built a self-exciting alternator as early as 1879. Details were also given as to early work on the Thomson arc lamps and dynamos, magnetic blow out, transformers, the "grounding shield," electric welding and the repulsion motor which now promises to be a formidable competitor to the direct-current motor for railway work. The first Thomson arc machine, built at New Britain, Conn., was capable of operating 4 arc lamps.

MR. WILLIAM E. KEILY has resigned his position as managing editor of the *Western Electrician*, following the change in ownership of that paper, which has resulted in its absorption by the *Electrical Review*. Mr. Keily's connection with the old paper ceased with its last issue, dated Oct. 31. He had been identified with the editorial conduct of the paper for a number of years, having been managing editor since 1899. During this time Mr. Keily made many friends and acquaintances in the electrical field, and he won their respect and esteem by his character and ability. A journalist by profession, with experience in both the general and technical fields, Mr. Keily plans to engage in literary work at his home in Chicago. He is an associate member of the American Institute of Electrical Engineers, member of the National Geographic Society and also of the Illuminating Engineering Society and the Electric Club of Chicago. He will have the hearty good will of his host of electrical friends in anything he may undertake.

CAPT. E. A. SAWTELLE.—A farewell dinner to Captain E. A. Sawtelle was given during the past month in the Hotel Cecil, London. About 75 of his most intimate friends gathered to bid him godspeed, and a most enjoyable evening was spent, tempered, however, by the regret that all felt in losing from their circle the society of a man who has always been one of the most popular of the American contingent in London. Mr. Blunt occupied the chair, and, in addition to his tribute to Captain Sawtelle, eloquent speeches were also made by Mr. Oscar Baldwin and Mr. George Flett. Captain Sawtelle has been in England in the Westinghouse interests for just about 10 years and had succeeded in establishing himself very firmly in the confidence and affection of Englishmen as well as his own countrymen settled in London. His career in England has been a successful and honorable one, and the warmest wishes were extended for his continued success on his return to America. Captain Sawtelle has also a host of warm friends in America to welcome him, and letters will for the present reach him in New York either care of the Westinghouse Company, 160 Broadway, or at the Engineers' Club.

MR. C. P. STEINMETZ is the subject of a long and interesting biographical sketch in the *New York Times* of November 1, which says about him among other things: "Electrical experts, by whom he is recognized as a past grand master, are the men who can tell you with nice appreciation of his contributions to the theory and practical usage of electricity. But ask them not, for their replies will be in a technical jargon, meaningless to the laymen. Nor will this article attempt any narration of his scientific achievements; electricity is such a mysterious, esoteric force that only the initiated can form any just estimation of the relative value of the discovery or invention of things electric. Instead, this is going to tell the story of Steinmetz's greatest achievement—an achievement which every one can appreciate—the story of what Steinmetz has made of himself. Nineteen years ago Charles Proteus Steinmetz, a newly arrived immigrant, was tramping the streets of Brooklyn, looking for a job. By perseverance he secured a twelve-dollar a week position as draughtsman in a small electrical plant. To-day he can tack an A. M. and a Ph. D. behind his name, and as consulting engineer of the General Electric Company draws a salary which cuts an impressive slice out of $100,000. Also he is professor of electrical engineering at Union College, author of text books and recognized as one of the world's greatest mathematicians."

Obituary.

MR. H. A. BUTTERS.—As announced by the executors of Henry A. Butters, the wealthy traction magnate of San Francisco, who died last week, the bulk of his fortune, estimated at several million dollars, will go to the testator's son, Henry A. Butters, Jr., who is attending Phillips-Exeter Academy in New Hampshire. Not only is Mrs. Butters excluded from participation, but her two daughters by a former marriage were cut off with bequests of $5 each.

E. V. BAILLARD.—It is with regret that we announce the death of Mr. E. V. Baillard, on the evening of October 24, in the forty-third year of his age. Mr. Baillard had been in poor health for some time, but the immediate cause of his death was a pleuritic attack which occurred a short time ago. He was a full member of the American Institute of Electrical Engineers and well known to electrical circles as an expert mechanician who made a specialty of solving difficult mechanical problems in the construction of new electrical and other inventions. A number of important electrical inventions owe their development in the practical stage to his technical skill and sound knowledge of electrical principles. He had a wide acquaintance and many sincere friends.

Trade Publications.

BEARINGS.—The Fairbanks Company, New York, has issued a folder illustrating and listing bearing pillow blocks, post hangers and rigid post boxes for line shaft installation.

STEAM CONDENSERS.—The products and facilities of the Wheeler Condenser & Engineering Company, Carteret, N. J., are strikingly outlined in a well-executed publication designated as Bulletin No. 101.

REX CATALOG.—W. H. Colgan Company, of West Newton, Mass., has just issued an attractive catalog descriptive of its line of Rex switch and outlet boxes. It is in handy form, well illustrated, and gives styles and prices.

RAILWAY SIGNALS.—Catalog No. 9 of the McClintock Manufacturing Company, St. Paul, Minn., deals with automatic electric motor operated signals for steam or electric railways. The devices employed are fully described and illustrated.

REFLECTORS.—The Holophane Company, 227 Fulton St., New York, has issued Bulletin No. 71, devoted to its new reflectors, designated as the "extensive," the "intensive" and the "focusing" types. The bulletin contains much valuable illuminating engineering data in the form of "rules-of-thumb" for the practical electrician, central station man, contractor and architect.

SPIRAL RIVETED STEEL PIPE.—The American Spiral Pipe Works, of Chicago, has just issued a 20-page illustrated circular, No. 22, showing some of the varied uses, advantages and economies of Taylor's spiral riveted pipe and forged steel flanges. This pipe, as shown by the circular, is extensively used in hydro-electric work and for exhaust piping in large steam plants.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is mailing circulars describing portable vest pocket voltmeters, ammeters and volt-ammeters for use in battery testing. These meters are particularly useful

to users of dry cells or storage batteries and their compact construction, combined with the long scales, makes them particularly useful in accurately determining the conditions of batteries.

LOGARITHMIC PAPER.—Mr. J. Norman Jensen, 797 North Leavitt Street, Chicago, Ill., has issued a unique circular containing a description of the uses to which logarithmic paper can be put. The description is printed on the reverse side of a sheet of logarithmic paper. The paper is particularly valuable for representing, in the form of straight lines, equations having an exponential member.

THE SPRAGUE ELECTRIC COMPANY, New York, is sending out circulars Nos. 432 and 433. The former illustrates a new line of fittings for use with its well-known make of flexible steel conduit, and No. 433 describes the new single-strip type of flexible steel conduit designed especially for fireproof building. Both circulars will be sent upon request to anyone interested.

SMALL MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued a reference supplement to its October monthly, giving a full list of manufacturers from whom various types of motor-driven appliances can be obtained. The monthly itself gives a complete account of the different types of motors actually in the company's stock at New York and St. Louis and contains many interesting articles relating to various motor applications.

LABORATORY RHEOSTATS.—The Ward Leonard Electric Company, of Bronxville, N. Y., is distributing a bulletin covering its laboratory rheostats, showing a 56-amp size, giving ampere divisions from 0.1 to 56 amp. The bulletin shows a diagram of connections. It is claimed that it is impossible to so manipulate the controller as to cause a "burn-out." This bulletin contains Mr. H. Ward Leonard's "Table of Equivalent Values of Electrical and Mechanical Units."

SMALL MOTORS.—Bulletin No. 3136 of the Emerson Electric Mfg. Co., St. Louis, Mo., deals with full-load automatic-start type of single-phase induction motors, rated at from 0.05 hp to 0.5 hp. Enclosed spherical type direct-current motors rated at from 0.05 hp to 0.17 hp are described in Bulletin No. 3214. Direct-current enclosed motors rated at from 0.125 hp to 0.5 hp are discussed in Bulletin No. 3215. Motor-driven exhaust fans for alternating-current and for direct-current service are treated fully in Bulletin No. 3505.

PORTABLE PHOTOMETERS.—Foote, Pierson & Co., 160 Duane Street, New York, have issud a well-prepared bulletin dealing with the Sharp-Millar portable universal photometer, which is adapted to the measuring of the candle-power of arc lamps, incandescent lamps and gas lamps, both in the laboratory and in the street. A bulletin of the same company is devoted to the integrating sphere, which affords a convenient and accurate means for determining the total flux on the mean spherical candle-power of a light source.

MINE TELEPHONES.—Stromberg-Carlson Manufacturing Company, of Rochester, N. Y., has recently issued a very complete descriptive pamphlet, Bulletin No. 1000, as to its telephones for mine work. It is not only admirably prepared, but is interesting as to contents. There is an opening discussion of the conditions involved, and then the apparatus is dealt with in very full detail. A list is given at the end of a large number of mining companies now using the "Mine-A-Phone" system built by these progressive manufacturers.

HIGH POWER MILLERS.—The Cincinnati Milling Machine Company, of Cincinnati, Ohio, has just issued a handsome and complete catalog, with descriptive text on its horizontal and vertical high-power millers, made for constant speed standard and right angle drives, constant speed motor drive and variable speed motor drive. The text is not only lucid and explicit as to all details, but is made even more interesting by the admirable cuts introduced frequently into the text. Complete specifications are also given for the various tools.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., announces that its Catalog A3 and Catalog A4 covering Ward Leonard navy type motor starting panels, fulfilling specifications of the Bureaus of Construction and Repair, Equipment and Steam Engineering, Nos. 2 M 1-1906, should not be used in quoting upon the latest specifications dated 1907 and 1908 of the navy. Enclosing cases for panels are specified in these latest specifications, and several minor changes. Customers are requested, meantime, to write for special quotations.

WATT-HOUR METER-TESTING RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., is issuing a new bulletin covering load rheostats for replacing lamp banks. Various ratings are shown from 10 amp to 23.5 amp at 120 volts, and from 5 to 12 amp at 240 volts. A combination or double-voltage rheostat giving 24 amp at 110 volts or 12 amp at 220 volts is listed. The statement is made that hundreds of these rheostats are in daily use by the leading electric light companies of America, and that among the more prominent users are the Edison Companies of New York, Detroit, Chicago, Brooklyn and the Public Service Corporation of New Jersey.

EXCELLO ARC LAMP.—The Excello Arc Lamp Company, 30 East Twentieth Street, New York, has just issued two handsome pieces of literature. One is a catalog devoted to the Excello flaming arc, about which many interesting details are given, inclusive of some illuminating engineering data. Pictures of the lamps are also shown with prices for lamps and carbons. The other pamphlet, entitled "Seen Everywhere," gives a number of excellent views of places in New York where these lamps have been installed, many of these views having already been shown in these pages. Such illustrations are typical of like use of the Excello lamps all over the country.

ALICE IN SWITCHLAND.—The Curtis Direct Advertising Company, of Detroit, has just brought out the copyright verses of Miss Sarah M. Sheridan, entitled "Alice in Switchland." These verses deal with Alice after the Wonderland story left off, and follow her through the greater realm of marvel, Electricity, in all its applications to the home. The pages are printed in colors, and the whole scheme of illustration is very effective. Miss Sheridan is one of the officials of the Detroit Edison system and has presented more than one paper of interest and value at electrical conventions. Although romantic by disposition, it was not known hitherto that she was also of a poetical turn.

ELECTRIC TIME.—An unusually handsome and effective descriptive catalog has been issued by the Dey Time Register Company, of Endicott, N. Y., whose electric time department includes electric clock programs, program systems, synchronized registering systems and synchronized cost-keeping systems. All the apparatus is clearly and beautifully illustrated and a great many useful and interesting details are given as to the master regulators, secondary clocks and other features. The catalog is in a sense a general one, but enough information is given to show how much care and ingenuity have been brought to bear on this important class of electrical apparatus, which ought to be in far more general use than it is. It may be noted that a neat switchboard is shown for use in connection with storage batteries.

BENJAMIN CLUSTERS.—The Benjamin Electric Manufacturing Company, of Chicago, Ill., has issued Catalog B-18, devoted to its wireless clusters and lighting specialties, dated October, 1908. It is most carefully and judiciously arranged in six classes of apparatus—cluster bodies, ceiling fixtures, pendant fixtures, special fixtures, weatherproof fixtures and miscellaneous materials, and has a full index. It is, in fact, a complete reference book for the Benjamin productions. The ceiling and pendant fixtures have been grouped on the basis of shades and reflectors used, rather than by the type of cluster body, and there are several new appliances shown. It may be noted that reductions in price are listed in several instances and that quantities in many standard packages have been reduced. The catalog is 80 pages, has a stiff cover, and is thumb-marked at each section.

PETTINGELL-ANDREWS COMPANY, Boston, Mass., is marketing a number of devices designed to prevent the theft of current. These will be fully described in the company's new monthly, *Juice*, the first issue of which will appear within the next few weeks. The O. K. fuse block cover and O. K. meter connection block are the devices that will be described in this issue. The former is a device for covering branch blocks so as to prevent illegal connection or the refuseing of blocks on discontinued services. The meter connection block is a device that makes it possible to carry the service wires in conduit from entrance to meter, leaving no exposed wires in the customers' premises. This block is so designed that it greatly facilitates the testing or replacement of meters. Any test may be made or a new meter substituted for one already installed without interrupting the customers' service, or the necessity of opening tap joints or cutting wires. These two devices are being extensively used by some of the larger central stations.

"SURFACE CONDENSERS" is the title of a 24-page, 8x10½-in. booklet just published by the Wheeler Condenser & Engineering Company. The contents include a chapter on the economy of condensing, another on the advantages of the several types of condensers, followed by a description of the Wheeler surface condensers with some remarks on the relative advantages of rectangular and cylindrical shells. The Volz combined feed-water heater and condenser, in which some of the tubes serve as a primary heater, is next described, after which there is a section on turbine condenser outfits. The final part of the catalog is devoted to notes and suggestions on the installation and operation of surface condensers. The illustrations, of which there are a large number, show not only the various types of Wheeler Admiralty and Wheeler-Volz surface condensers of the rectangular and cylindrical patterns, and water-works condensers, but also include a considerable number of the largest steam power plants in this country. This booklet forms one of a series of engineering treatises which the Wheeler Condenser & Engineering Company is distributing.

BUREAU IN EUROPE.—We are advised by Pitt & Scott, Ltd., import and export freight agents, 35 Broadway, New York, that for the purpose of filling a need of American manufacturers for better facilities abroad the Bureau of American Manufacturers in Europe has recently been organized and is open to all reputable American firms. This bureau has leased a large six-story building in the business heart of London, England, and foreign buyers visiting that city will be invited to attend the exhibition of American goods which will be carried permanently. A monthly bulletin will be sent to buyers in every quarter of the globe, personal letters will be dispatched to them at frequent intervals and every mode of advertising consistent with progressive business methods will be employed to make the exhibit a profitable enterprise for the members participating. A staff of experienced salesmen will be engaged, possessed of mechanical educations in the lines to be demonstrated, writing rooms and private conversation rooms will be maintained, and buyers will be served as carefully and as thoroughly as would be possible at the home offices of the respective members. A comprehensive system of reports between Europe and America is expected to keep the members in close touch with foreign conditions and it is anticipated that a large increase in exports will attend this new departure.

TRANSFORMERS.—The Moloney Electric Company, St. Louis, Mo., has issued a well-illustrated, neatly printed catalog giving valuable information concerning the construction and test of transformers. The advantageous features of its line of high-efficiency transformers are thoroughly discussed.

NERNST LAMPS.—Bulletin B of the Nernst Lamp Company, Pittsburg, Pa., gives a good description of multiple-glower lamps and indicates their performance. These lamps are of the improved type, having a decreased specific power consumption, that is, an increased output per watt of input. Complete price lists of lamps and parts are included.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing circulars describing the Okonite automobile and motor boat primary and secondary wires. Particular attention is called to the method of spirally stranding the wires and the use of Sea Island cotton in conjunction with 30 per cent best dry fine Para rubber. This circular will be of interest to those in need of this class of conductor and can be secured upon application.

Business Notes.

NORTHERN CRANES.—The Northern Engineering Works, Detroit, Mich., has recently installed a 5-ton, 40-ft. crane in the pumping station of the Brownsville (Pa.) Water Company, a 10-ton, 40-ft. crane in the works of the Pittsburg-Buffalo Company, Ellsworth, Pa., and a 1-ton, 3-motor electric locomotive crane in the plant of the Worcester Salt Company.

THE U. T. HUNGERFORD BRASS & COPPER COMPANY is making a specialty of tinned copper wore. The facilities at its command enable it to produce wire of this kind conforming to the very highest standard. It uses only copper of the highest electrical conductivity and tin of the greatest purity. The wire is furnished in long continuous lengths, in coils or on reels as may be required. It is the aim of the company to produce wire as exact to gage as the process of drawing wire will permit, and its efforts in this direction are appreciated by large consumers throughout the country.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Elfctrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Car Lighting Engineers. Secretary, G. B. Colegrove, Chicago. Next meeting, Chicago, Nov. 18.

Association of Edison Illuminating Companies. Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronton, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Cleveland Engineering Society. Secretary, J. C. Beardsley, 718 Caxton Building, Cleveland, O.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 500 Fifth Ave., New York.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Ottawa, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and 32d St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Cedar Rapids, Ia., April, 1909.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. L. Clary, Sikeston, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Temporary chairman, J. D. Crary, Aberdeen, Wash. Next meeting, Seattle, 1909.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Toledo, O., Nov. 20 and 21.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

PENNSYLVANIA ELECTRIC ASSOCIATION. E. L. Smith, Tonawanda, Pa., secretary.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday each month. Next annual meeting, fourth Monday in February, 1909.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 27, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N.Y.]

901,942. WAVE-RESPONSIVE DEVICE; Clifford D. Babcock, New York, N. Y. App. filed Aug. 27, 1906. A wireless telegraph detecting device, including a crystalline substance, such as carborundum, held between spring contacts.

901,955. ADJUSTABLE LIGHT FIXTURE; George W. Craighead, Richmond, Ind. App. filed Nov. 20, 1907. Adjustable light fixture having telescoping parts whereby the time and labor necessary for installing chandeliers, or the like, are reduced to a minimum.

901,958. RAILWAY SIGNAL; Heinrich Diehl, Berlin, Germany. App. filed April 23, 1907. Signal system in which the control of the signals is secured by selenium cells placed along the trackway and sources of light on the cars.

901,965. PREPARATION OF ELECTROTYPE MOLDS; Albert W. Harrison, Baltimore, Md. App. filed July 16, 1906. Relates to the preparation of molds for electrotypes designed to avoid the time-consuming steps hitherto required. Consists of an electrolyte including a mineral having a lower conductivity than the metallic base of the salt of the electrolyte.

901,966. SOLUTION FOR TREATING ELECTROTYPE MOLDS; Albert W. Harrison, Baltimore, Md. App. filed Dec. 7, 1906. A solution for treating electrotype molds consisting of nitrate of soda dissolved in water with graphite added thereto.

901,967. OIL SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed Nov. 7, 1904. Electric switch of the oil break type employed in handling currents of high potential and large amperage. The oil is maintained under pressure in a portion of the system and released to throw the switch and extinguish the arc. For the latter function the oil is caused to flow over the terminals of the separating electrodes.

901,974. TELEPHONE REPEATER; Lucius A. Lindsey, Crystal Springs, Ga. App. filed March 20, 1906. A telephone repeater having a carbon button, one of the plates of which is attached to the diaphragm, there being a coil mounted on such diaphragm and a separate core in co-operative relation with the coil, the said core being mounted independently of the diaphragm, and an exciting coil in co-operative relation with the core.

901,976. CURRENT-COLLECTING MEANS; Campbell MacMillan, Schenectady, N. Y. App. filed Feb. 12, 1906. A collector ring for alternating-current generators, including parts having annular recesses in which a frame having numerous brushes is loosely contained and guided by rollers.

901,977. MICROPHONE APPARATUS FOR TELEPHONE AND OTHER CIRCUITS; Quirino Mahorana, Rome, Italy. App. filed July 7, 1906. Microphone for telephone and sound-carrying systems in which a liquid jet is employed in the circuit for the purpose of reproducing the sounds transmitted by producing very intensified variations of current in the circuit and, therefore, very intensified sounds.

901,981. SUSPENSION DEVICE FOR TROLLEY WIRES OR OTHER CONDUCTORS CARRYING CURRENTS OF HIGH VOLTAGE; George A. Mead, Mansfield, Ohio. App. filed Dec. 2, 1904. A suspension device for trolley wires having an insulator sleeved on a laterally extending arm and a brace rod strapped to said insulator and supporting the trolley wire.

901,983. BURGLAR ALARM; Carl A. Metzger, New York, N. Y. App. filed Feb. 15, 1908. A burglar alarm which is actuated by the introduction of a key or tool into a lock. Includes a spring in the path of the key and adapted to be depressed thereby.

901,993. CARBON PENCIL FOR ELECTRIC ARC LIGHTS; John Nicholson, Frackville, Pa. App. filed April 20, 1908. An electrode for an arc light comprising a cored carbon pencil having a metal cap and a metal strip secured to said cap and extending substantially centrally through the core.

901,997. ELECTRIC RAILWAY SYSTEM; Horace F. Parshall, London Wall, London. App. filed Aug. 19, 1904. The trolley wire has a higher elevation at its high potential portions than at its low potential portions. A switch is controlled by the movement of the trolley pole so as to connect the motors properly for the high potential or the low potential current.

902,003. ELECTRIC FIREPLACE; Alfred D. Rathbone, Grand Rapids, Mich. App. filed Feb. 4, 1908. Details of a stamped sheet metal fireplace having pockets to receive incandescent lamps and establish reflecting surfaces therefor.

902,004. PLURAL-LAMP FIXTURE; Frank J. Russell, New York, N. Y. App. filed Oct. 20, 1906. A cluster lamp socket having a pair of concentric hemispherical shells, which respectively establish the center contacts and the sleeve contacts for the lamp.

902,014. SIGNALING SYSTEM FOR RAILROAD TRAINS; Shellman T. Stewart, Newark, N. J. App. filed Jan. 31, 1908. A train signal system comprising a circuit for a signal, gates to make and break the circuit, latches for holding the gates shut, and a second circuit to operate the latches.

902,019. DYNAMO-ELECTRIC MACHINE; Karl Sulzberger, Charlottenberg, Germany. App. filed April 8, 1905. In combination, a core comprising a body portion and integral projections extending therefrom, and conductor holders secured to said body portion and combining with the integral projections to form a substantially cylindrical member, some of said coil holders being formed of magnetic material, and others of non-magnetic material, said cylinder member having conductor-receiving recesses formed therein.

902,020. DYNAMO-ELECTRIC MACHINE; Karl Sulzberger, Charlottenburg, Germany. App. filed Dec. 12, 1906. In combination, a core having an axially extending undercut slot or groove formed in its surface, conductors formed into a loop or coil thereto and proportioned so that a space extends between one end of said loop or coil, and a conductor holder having a tenon fitted to said slot, radially inserted into said space and then moved axially into said slot.

902,024. ELECTRIC HEATER; Elihu Thomson, Swampscott, Mass. App. filed June 17, 1907. An electric heater comprising a fluid container, an electric heating device in heat-conductive relation thereto, and a corrugated casing forming a condensing space communicating with the fluid.

902,026. RAIL BOND; Eugene W. Vogel, Chicago, Ill. App. filed Feb. 9, 1906. A rigid terminal for an electrical bond adapted to be driven into a hole in a conductor and having shallow superficial grooves in the portion thereof which is adapted to engage with the wall surrounding the hole.

902,028. ELECTRIC SIGN; Henry J. Walser, Cleveland, Ohio. App. filed May 29, 1906. An electrical advertising sign, or device, consisting of a panel on which incandescent lamps, or the like, may be arranged to form letters or numerals. Specially constructed lamps are employed with long threaded studs, which are screwed into a receiving plate wherever holes are bored and tapped.

902,032. INCANDESCENT ELECTRIC LAMP; Willis R. Whitney, Schenectady, N. Y. App. filed Oct. 31, 1904. In an incandescent lamp, the combination of a bulb, a screw cap of thin metal tightly inclosing the contracted portion of the bulb so as to be under tension, a glass tube tightly inclosed by the screw cap, the latter being under tension about the tube, and a metal cap tightly closing the outer end of said tube and being under tension.

902,033. SWITCH MECHANISM; John B. Wiard, Lynn, Mass. App. filed April 28, 1906. A switch for controlling electric circuits and comprising two sets of resilient contact fingers, and a rocker member having two sets of tubular contact members arranged with their axes parallel to the axes of the rocking member.

902,035. ELECTRIC RAILROAD SWITCH; Merle J. Wightman, New York, N. Y. App. filed Jan. 2, 1908. Mechanism for moving a switch point. Includes an electric motor having worm gear connections for operating the switch point and having its circuit controlled by a trolley contact.

902,040. WIRE CONNECTOR; Homer W. Wyckoff, Indianapolis, Ind. App. filed March 12, 1906. A pair of plates with grooves are adapted to clamp together on the conductors by a connecting bolt.

902,043. TELEPHONE TRANSMITTER; George F. Atwood, East Orange, N. J. App. filed March 12, 1906. The combination with a telephone transmitter, of a containing case therefor, a chamber secured to the rear wall of the case, said wall having a hole therein opening into said chamber, and an insulated block carrying the transmitter terminals projecting through said opening into said chamber.

902,048. MOLDED RESISTANCE; Lawrence E. Barringer, Schenectady, N. Y. App. filed Feb. 2, 1906. A resistance conductor comprising a compound of a comminuted conducting material and hydrous silicate of calcium.

902,061. MOTOR CONTROLLER; Henry F. Elshoff, Norwood, Ohio. App. filed June 30, 1906. The controller has a rotatable drum, a switch biased toward closed position, but arranged to be opened by said drum when the latter is moved between certain positions, and clockwork mechanism for retarding part of the closing movement of said switch only.

902,065. DYNAMO-ELECTRIC MACHINE; Allan B. Field, Norwood, Ohio. App. filed May 13, 1907. Dynamo-electric machine having a plurality of field pole pieces and conducting rings for bracing the pole pieces and for retaining the field coils in place. Conducting rods pass through the pole pieces and connect said conducting rings.

902,069. INCANDESCENT LAMP; Hugo Gernsback, New York, N. Y. App. filed March 12, 1907. A specially designed filament for automobile headlights having a plurality of separate threads in parallel between vertical uprights.

902,099. SELECTIVE SIGNALING DEVICE; Ira F. Manny, Milwaukee, Wis. App. filed Dec. 12, 1907. Selective signaling device for use with a telephone system, designed to be placed in the same electrical circuit at the several stations and caused to be set in operation from the central or signaling station.

902,101. MOTOR CONTROLLER; Anthony L. McHugh, Cincinnati, Ohio. App. filed June 30, 1906. Consists of the combination of a controller arranged to impress different voltages on a motor armature, a resistance in the motor armature circuit, a mechanically operated switch separate from the controller drum and its co-operating contact fingers and arranged to normally short-circuit said resistance, but to open said short circuit whenever the voltage impressed on the motor armature is varied.

902,105. ELECTRIC BELL; Charles H. North, Cleveland, Ohio. App. filed April 22, 1905. Has means for mounting the armature and associated bell-tapper whereby the pivotal mountings of prior bells are avoided, and the device is made more sensitive in the response to suitable ringing currents.

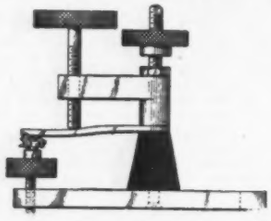
902,106. METHOD OF AND MEANS FOR UTILIZING THE PRESSURE IN THE INTERIOR OF AN ELECTRIC CONDUCTOR CARRYING CURRENT; Edwin F. Northrup, Philadelphia, Pa. App. filed March 1, 1907. The method of producing motion electrically, which consists in passing an electric current through a conductor to cause internal pressure in the mass of said conductor, and causing the said pressure to act upon a body capable of motion.

902,108. MOTOR CONTROLLER; William D. Pomeroy, Norwood, Ohio. App. filed Dec. 31, 1906. Comprises a controller having a rotatable drum, and a switch arranged to be opened by said drum when the latter is moved between certain positions, together with means which tend to close said switch and friction mechanism for retarding such closing.

902,118. SIGNAL SYSTEM; Burt A. Slater and Michael J. McDermott, Boise, Idaho. App. filed March 5, 1908. Means to notify the engineer that the station agent at the station which he has passed is not at his post of duty. Includes a spring-impelled tappet adjacent to the usual track rails and depressed by the wheels of the engine in passing.

902,121. ELECTRIC FIXTURE; Edgar C. Suiter, Olympia, Wash. App. filed April 30, 1907. A spring reel over which the flexible cord depends and which has means for retaining the lamp at any required elevation.

902,157. PROCESS FOR PRODUCING PHOSPHORIC ACID; Frederick J. Maywald, Brooklyn, N. Y. App. filed Sept. 10, 1902. The process of treating phosphates which consists in producing a low potential arc in a granular mass of phosphates having an earthy base



901,942—Wave Responsive Device.

and heating such phosphates to a dissociating temperature, thereby decomposing the same into phosphoric oxid and base, and in collecting the fumes of phosphoric oxid as such.

902,175. ELECTRIC CELL; George Schauli, London, Eng. App. filed Sept. 18, 1906. An electrode composed of a continuous fluid tight plate and a perforated plate in metallic contact therewith throughout the entire area of one surface of the perforated plate.

902,176. RAILWAY SIGNALING SYSTEM; Carl J. Schwarze, Adrian, Mich. App. filed July 19, 1906. A pair of special trolley connections are hung adjacent to the usual trolley wire and engaged by a laterally projecting rod from the trolley harp so as to become temporarily electrified.

902,184. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed March 20, 1905. Automatic fluid pressure brake having an electric application valve for controlling the supply of air to the brake cylinder, and a normally open electric release valve for controlling the exhaust port of the pneumatically operated valve.

902,195. TELEPHONE RELAY; Ernest F. A. Alexanderson, Schenectady, N. Y. App. filed Jan. 25, 1908. A telephone relay comprising a high-frequency inductor alternator having a stationary field winding connected in the primary circuit and a stationary armature winding connected in the secondary circuit.

902,216. ELECTRIC LAMP FOR HELMETS AND SIMILAR HEAD COVERINGS; Johann Heinrich Drager, Lubeck, Germany. App. filed Jan. 2, 1908. A tubular device screwed on the helmet of a diver's apparatus contains a dry battery and miniature incandescent lamp.

902,235. CABLE TIP; Louis Kellner, New York, N. Y. App. filed Nov. 11, 1907. A cable tip designed to secure the greatest possible conducting efficiency in a compact, simple structure which is easily attached and detached from the cable conductor. Makes use of a split conical wedge which is impelled in a taper recess by an abutting screw at its large end.

902,249. SWITCH-POINT THROWER; Rechichi Pasquale, Oil City, Pa. App. filed April 11, 1907. A rotary cam device having a link connection with a switch-point and which is rotated by a depending tappet on the car.

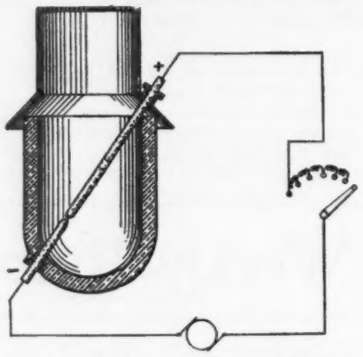
902,262. INSULATOR PROTECTOR; Robert R. Sparks, Greenfield, Mass. App. filed May 20, 1908. An ordinary insulator has a protecting hood to prevent breakage and leakage of current.

902,275. BANK OF LOCKING SWITCH-KEYS; Elmer R. Corwin and Charles A. Bals, Chicago, Ill. App. filed March 28, 1908. A stitch key comprising a non-conducting plunger, switch-contact members adapted to be operated by the plunger, switches adapted to be controlled by the switch-contact members, means whereby a partial depression of the plunger operates both of the switch-contact members to control respective switches, and means whereby a still further depression of the plunger operates only one of the switch-contact members still further to control an additional switch.

902,285. CONDUIT; John A. Garey, Mound City, Mo. App. filed Aug. 12, 1907. The third rail has a cover which flexibly covers over the same and is supported during the passage of the collector shoe by the engagement of the latter.

902,297. RAILWAY SIGNALING APPARATUS; Winthrop K. Howe, Buffalo, N. Y. App. filed Nov. 27, 1905. A means for operating the two blades of a semaphore signal independently from a signal motor. The motor has separate clutches for the separate blades.

902,307. ELECTRIC CONTROLLING DEVICE; Harry W. Leonard, Bronxville, N. Y. App. filed May 13, 1905. A rheostat having a



902,157—Process for Producing Phosphoric Acid.

plurality of self-adjusting contact skates, and a series of stationary rheostat contacts engaged by said skates, the material of the skates and stationary contacts being different.

902,338. TELEPHONE SYSTEM; Paul V. Smith, Lyons, Kan. App. filed Dec. 22, 1906. Plurality of telephones selectively put in circuit by dial and step by step mechanism.

902,354. ELECTRODE FOR ARC LAMPS; Willis R. Whitney, Boston, Mass. App. filed Dec. 10, 1903. An arc light electrode formed out of a pure metal having a melting point materially higher than iron and yielding a luminous or flaming arc.

902,356. FOUR-PARTY-LINE INDICATING RINGING KEY; Charles S. Winston, Chicago, Ill. App. filed Aug. 3, 1907. In an operator's indicating key, the combination with a suitable supporting frame, of a plurality of switch-actuating plungers, a plurality of auxiliary plungers, one associated with each of the actuating plungers adapted by their positions to indicate the last actuating plunger depressed.

902,373. SPARK PLUG ATTACHMENT; Frederick D. Casey, North Water Gap, Pa. App. filed July 25, 1907. The spark plug has a dome-shaped housing which protects the insulator from deposits of moisture.

902,396. CONTROLLING SYSTEM FOR ELECTRIC MOTORS; Jay H. Hall, Cleveland, Ohio. App. filed March 13, 1906. A system for controlling electric motors from a distant point and including switches which are preferably closed by electromagnets and opened by springs or weights.

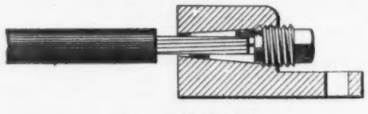
902,420. TROLLEY GUARD; William D. Lewis, Plymouth, Pa. App. filed April 11, 1908. The trolley harp has a pair of arms with curved extremities spring impelled vertically upward on both sides of the trolley wheel.

902,424. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; Frederick H. Loring, London, Eng. App. filed Dec. 31, 1907. Provides two or more segmental commutators in juxtaposition which can be built up and insulated in a substantial manner, without necessarily occupying any more space than a single commutator of equivalent conducting capacity. The different segments are formed so as to interlock together.

902,455. TRANSPOSITION BRACKET FOR INSULATORS; James E. Skinner, Kingman, Kan. App. filed June 17, 1908. Four insulators are mounted on cross-arms at different elevations so as to guide the conductors into transposed relation along the line.

902,476. ELECTRIC LOCOMOTIVE; William Dalton, Schenectady, N. Y. App. filed July 22, 1907. Designed for a locomotive in which the weights are comparatively low and in which injury due to nosing or lateral motion of the locomotive on its trucks is prevented. The locomotive has eight pairs of wheels forming part of two bogie trucks.

902,499. INDICATOR MAGNETO ALTERNATOR; Leon Le Pontois, New Rochelle, N. Y. App. filed Oct. 24, 1907. In a magneto gen-



902,235—Cable Tip.

erator, the combination of an element comprising a permanently magnetized portion of hardened iron and a polar portion of soft iron integral therewith, a second element for controlling the path of the magnetic flux, and a winding on one of said elements.

Reissue. 12,871. PROCESS OF TREATING NEGATIVE POLE PLATES; Joseph Bijur, New York, N. Y. App. filed Jan. 14, 1908. The process of treating plates adapted for use as negative pole plates, which consists in soaking the plate in a solution capable of penetrating the pores of the plate and there depositing an inert substance.

Reissue. 12,872. NEGATIVE POLE PLATE; Joseph Bijur, New York, N. Y. App. filed Jan. 14, 1908. A negative pole Planté plate having inert material incorporated within the active material and characterized by a brownish-gray color before use and a spongy appearance, an increased porosity of the active mass and a substantially sustained capacity in use.